

**East Prince William Sound Landscape Assessment**  
**Cordova Ranger District**  
**Chugach National Forest**  
September 9, 2008



*Narrows at head of Fidalgo Bay, East Prince William Sound (August 2007)*

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## **Executive Summary**

The East Prince William Sound Landscape Assessment is an ecosystem analysis at the landscape scale that involves both information gathering and analysis. The purpose is to document and develop an understanding of the processes and interactions occurring in the mainland portion of the Cordova Ranger District of the Chugach National Forest in Alaska that lies between Valdez Arm near Valdez, Alaska and Nelson Bay north of Cordova. The analysis covers 528,630 acres as displayed in Figure 1.1.

This report identifies the important issues and key questions and describes the biological, physical, and social features for the area. Information included in this document describes water uses, vegetative patterns and distribution, disturbance factors, fish and wildlife species and habitats, hydrology, soils, and cultural, socio-economic, subsistence, and recreational human use patterns.

Landscape analyses are a step between a forest plan and project implementation. They provide a means of refining the desired condition of the landscape given the Forest Plan goals and objectives, management prescriptions, and standards and guidelines, current policy, and other applicable State and Federal regulations. They provide an opportunity for managers and users to brainstorm monitoring and inventory needs and projects to help reach the desired future condition. The end result is not a decision document but a report that can be used in future site-specific analyses and planning. These documents are updated as new information comes to light or projects identified. The most up-to-date version of the entire landscape assessment and Chapter 5 are available on the Forest Service, U.S. Department of Agriculture Region 10 website. Any hard copy is valid as of the date on the front cover.

A team of resource specialists from the Chugach National Forest Cordova Ranger District and Supervisor's Office prepared this assessment with input solicited from other federal and state agencies, the communities of Cordova, Tatitlek, and Valdez, local Tribal Governments, landowners, and the general public (Appendix C).

The following are the steps used to conduct the analysis and corresponding chapters in this report.

- Step 1 – Delineate analysis area and describe desired conditions (Chapter 1)
- Step 2 – Describe the current conditions of the landscape (Chapter 2)
- Step 3 – Identify key issues and questions (Chapter 3)
- Step 4 – Describe trends and information gaps (Chapter 4)
- Step 5 – Recommend monitoring needs and projects (Chapter 5)

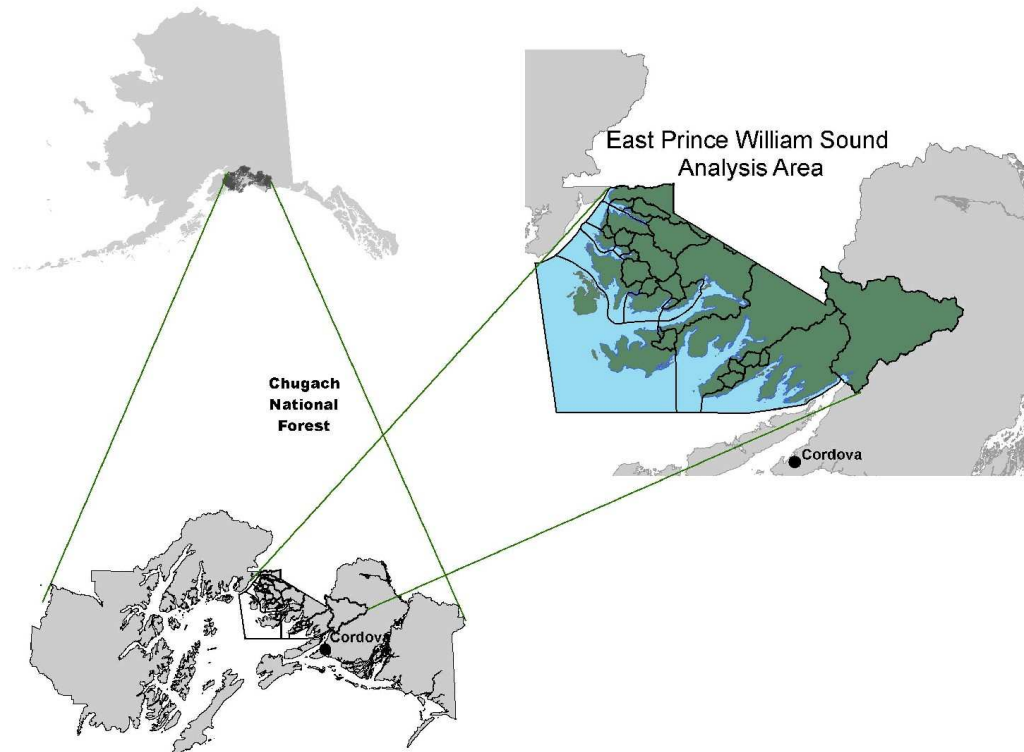




# Chapter 1

## ***Purpose***

The purpose of this landscape scale ecosystem assessment is to develop and document our understanding of the processes and interactions that occur in the analysis area and determine how we can achieve our desired future condition described in the revised Chugach National Forest Land and Resource Management Plan (Forest Plan) and Record of Decision (ROD) signed in May 2002. The East Prince William Sound analysis area is defined by the watershed associations that comprise the northwestern most portion of the Cordova Ranger District of the Chugach National Forest from Valdez Arm east to Nelson Bay (Figure 1.1 and 2.2).



**Figure 1.1 - Location of the East Prince William Sound landscape analysis area.**

## ***The Analysis Area***

This 528,630 acre or 826 square mile analysis area is located in southcentral Alaska west of the town of Cordova from Nelson Bay to Valdez Arm. It is bounded by State of Alaska lands to the north and Prince William Sound to the south. Access is by watercraft or aircraft. No maintained roads exist on National Forest System lands.

The area is characterized by complex coastlines, peninsulas, and small islands reaching out into Prince William Sound from the high peaks of the Chugach Range to the east. The rocky coast is interspersed with small beaches, bays and estuaries. The uplands consist of

coniferous forests and muskegs, which transition into alpine meadows and rugged peaks, some with remnant glaciers. The topography includes glacial carved valleys and ranges from rolling to steep. Besides past glacial activity, Prince William Sound and its associated weather patterns are the major driving forces controlling the landscape.

Users of this area enjoy kayaking, boating, fishing, hunting, camping, hiking, and heliskiing (on State lands). However, the area is lightly used by recreationists due to its remoteness and limited accessibility. One public use cabin is present in Jack Bay. No other developed recreation facilities exist on National Forest System lands within this analysis area.

## Landownership

About 24.3% of the analysis area is Native Corporation land. There are scattered parcels of other private land in Jack Bay, Ellamar, Snug Corner Cove, Fidalgo, and Alice Cove as well as some State land. Table 1.1 and Figure 1.2 summarize and display the land ownership of the area.

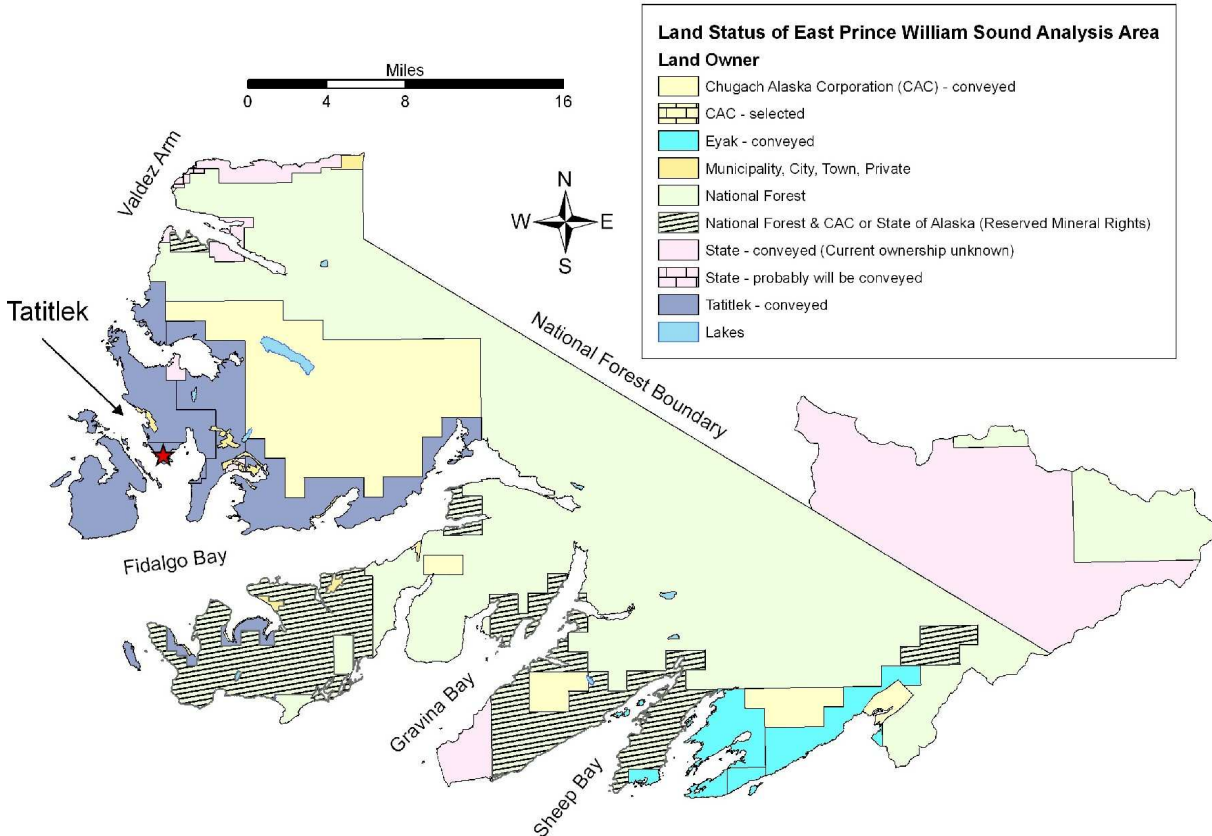


Figure 1.2 – Land ownership patterns in the East Prince William Sound analysis area.

**Table 1.1 - Summary of land ownership for the analysis area**

<b>Ownership</b>	<b>Acres</b>	<b>% of area</b>
Chugach Alaska Corporation (CAC)	65,687.5	12.4 %
CAC - selected	0.1	0.0 %
Eyak Corporation	16,264.1	3.1 %
Municipality, City, Town or Private	2,836.9	0.5 %
National Forest System Land	253,761.4	48.0 %
National Forest with reserved mineral rights by CAC or State of Alaska	60,653.5	11.5 %
State - (Current ownership unknown)	80,648.2	15.2 %
State - probably will be conveyed	395.2	0.1 %
Tatitlek Corporation	46,811.5	8.9 %
Fresh Water	1,571.9	0.3 %
<b>Total</b>	<b>528,630</b>	<b>100 %</b>

Under the Alaska Native Claims Settlement Act (ANCSA), the Native corporations were granted land selections including “over-select” lands. The Tatitlek Corporation, Chugach Alaska Corporation, and Eyak Corporation were all granted selections in the analysis area. Starting in 1996, the *Exxon Valdez* Oil Spill (EVOS) Trustee Council determined that the purchase of fee simple interest and conservation and timber easements of some of these corporation lands was an appropriate means to restore a portion of the injured resources and reduced services caused by the *Exxon Valdez* Oil Spill. Beginning in 1997, EVOS restitution funds were used to acquire several parcels and purchase conservation and timber easements in the analysis area. The parcels where fee simple interest was purchased became part of the Chugach National Forest system. Chugach Alaska Corporation (CAC) retained subsurface rights on several of these parcels.

### ***Desired Future Condition***

#### **Chugach Forest Plan management direction**

The Record of Decision for the revised Chugach Forest Plan was signed in May 2002 (USDA Forest Service 2002a). Chapter 3 of the Forest Plan outlines forest wide direction, goals and objectives, and standards and guidelines. It also describes the desired future condition for the forest as a whole with regards to each resource. Chapter 4 of the Forest Plan provides a detailed description of the management area prescriptions and desired future condition for ecological and social systems, and allowed activities, standards, and guidelines. Chapter 5 of the Forest Plan includes monitoring, evaluation, information and research needs, and potential projects.

Chapter 3 of the Forest Plan outlines the desired conditions for the East Prince William Sound geographic area on pages 3-16 to 3-18. It states that these lands are managed primarily to maintain the wild and natural character and its unique wildlife.

Owing to the rarity of non-native invasive plants in the area, land managers of the East Prince William Sound area are in a unique position to prevent problems with non-native invasive plant species. Prevention is generally much cheaper than control and identifying outbreaks early and responding to them quickly can reduce costs. An active program in non-native plant survey and control is specified by the following text from the Revised Forest

Plan page 3-4 (USDA Forest Service 2002c): “Prevent introduction and spread of exotic plants and reduce areas of current infestation”.

The Forest Plan states that human access will remain almost exclusively by boat or aircraft. The majority of the National Forest System lands are only open to motorized use for subsistence purposes only year round. The exception is the two isolated parcels north of State of Alaska land in the upper Rude River drainage. These parcels are open to all motorized use in the winter and open to motorized use by helicopters in the summer.

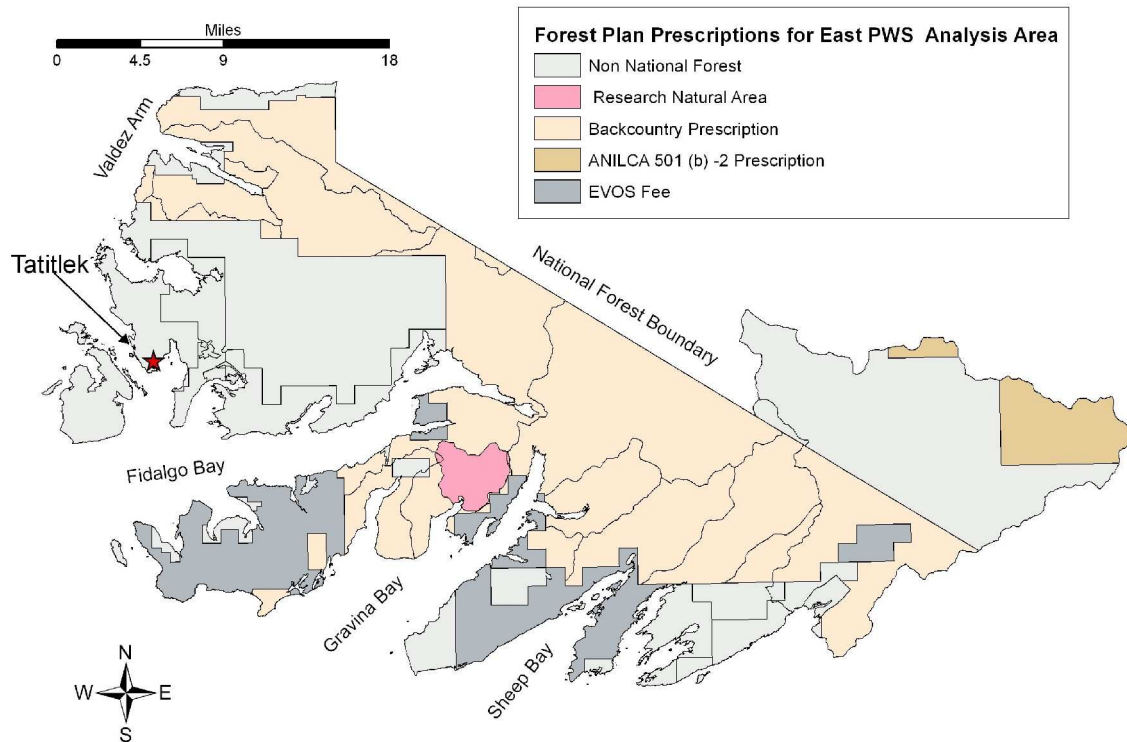
The Forest Plan states that recreation and tourism is focused on the summer months with little activity occurring during the winter and that most of the recreation will occur along the immediate shoreline by motorized boat or sea kayak access. The limited shoreline areas capable of handling dispersed recreation groups will be maintained in good condition appropriate for their recreation opportunities. Some dispersed hiking, hunting, skiing, mountaineering and fishing will occur on upland areas. The remote and spectacular setting will continue to provide commercial tourism business opportunities. Some accommodation will be provided for visitors.

Development of commercial facilities will occur on lands other than the Chugach National Forest. Resource development and use will be limited to activities on private lands. Existing mining claims, subject to valid existing rights will continue. Commercial float facilities may be developed in Sheep Bay, Simpson Bay or the entrance to Port Fidalgo. State mariculture facilities continue their operations consistent with the overall fishery management policies. Private landowner with inholdings and holders of valid mining claims will have reasonable access to their lands. The means of access will be consistent with the management area direction and emphasis. (USDA Forest Service 2002c)

The Forest Plan also states the desire for the area to recover completely from the effects of the *Exxon Valdez* Oil Spill and that major seabird and marine mammal colonies will continue to flourish with minimal impact from human disturbance. Species such as Steller sea lions, sea otters, black oystercatchers, marbled and Kittlitz murrelets and dusky Canada geese will be sustained (USDA Forest Service 2002c). It is desired that the wildlife typical of Alaska such as brown and black bear, gray wolf, bald eagle, osprey, mountain goat, and Sitka black-tailed deer be sustained, and deer and goat provide hunting and subsistence opportunities (USDA Forest Service 2002c). The waters of Prince William Sound will continue to be highly productive for fishing. Anadromous fish runs of sockeye, pink, coho, and chum salmon along with cutthroat trout and Dolly Varden char will be abundant (USDA Forest Service 2002c).

Management prescriptions for the analysis area include 210 – Backcountry, 221 – EVOS Fee, Timber and Conservation Easements with and without public access, 141 - Research Natural Area, and 213- ANILCA 501(b)-2 Prescriptions (Fig. 1.3). The 210 – Backcountry prescription was developed to address the “Management of Fish and Wildlife Habitat” and “Natural Quiet” interests. The 221 – EVOS Acquired lands management prescription was developed to specify management direction for lands or interests acquired with *Exxon Valdez* Oil Spill restoration funds. The 141 – Research Natural Area prescription emphasizes

non-manipulative research, monitoring, education, and the maintenance of natural diversity allowing natural physical and biological processes to prevail without human intervention. There are two isolated national forest parcels north of State of Alaska lands in the upper Rude River drainage that have the 213- ANILCA 501(b) Prescription. This prescription emphasizes the conservation of fish and wildlife habitats (USDA Forest Service 2002c).



**Figure 1.3 - Forest Plan direction for the East Prince William Sound analysis area**

**Backcountry (210)** - This prescription emphasizes managing most of the mainland between Valdez Arm and Nelson Bay for a variety of recreational opportunities for backcountry activities in natural appearing landscapes. Scenic integrity objectives range from moderate to high. The desired condition is for these islands to provide opportunities for solitude, isolation and quiet. Recreation Opportunity Spectrum (ROS) classes will range from Primitive to Semi-Primitive. The characteristics for level of solitude, encounters, access, facilities and trails of these ROS classes are described in Table 3-8 on pages 3-38 and 3-39 of the Forest Plan. Recreation cabins may be present and new cabins may be constructed. Vegetation will be mostly late successional. Modifications to the vegetation as well as fish and wildlife habitat improvements may be present, blending into the area's natural features. Heritage resources will remain in an undisturbed state, with data recordation as the preferred method to mitigate the loss of heritage resources. Above ground historic features will be present in their natural state with minimal on-site interpretation. Locatable minerals activities are allowed and mineral material sales are "conditional". Small mineral materials sites may be developed to support trail or facility construction. All sites will be completely rehabilitated upon completion of projects (USDA Forest Service 2002c). Refer to pages 4-34

to 36 of the Forest Plan for addition information about management intent, area specific standards and guidelines, and allowed activities.

**EVOS Acquired Lands (221)** - This restrictive designation prescription applies to several parcels between Port Fidalgo and Nelson Bay (Fig. 1.2). The primary goal for lands where the surface estate has been purchased and become part of the National Forest system in fee is to maintain the land in perpetuity for conservation and restoration purposes. All subsurface rights and minerals are privately owned by Chugach Alaska Corporation and available for them to develop. This right cannot be denied. Mineral materials, if owned by the subsurface owner could be developed by them; the Forest Service could not sell these mineral materials. Likewise without subsurface ownership, the government cannot allow development of any leasable minerals, should any exist.

Forest Service development activities are only allowed when necessary to convey information to the public to provide public safety, protect natural resources, for research or managing the area for conservation or wilderness purposes. These lands are closed to recreational motorized use. On Timber Conservation easements, the Native corporations retain all rights to surface ownership except the right to harvest timber. The purpose of Conservation Easements is to ensure that the conservation value of the property is maintained by the Native corporations and to prevent any use of the property that impairs or interferes with its conservation values. Public access is not allowed on several of these conservation and timber easements. The individual purchase agreements describe detailed management requirements for each parcel. Refer to pages 4-40 to 4-45 of the Forest Plan and the Forest Plan prescription map for more information.

**Research Natural Area Management Area (141)** - The Record of Decision for the Forest Plan established a 6847 acre Research Natural Area (RNA) for the Olsen Bay watershed. The management intent for RNA's is to serve as a baseline reference area for measuring long-term ecological change. They are characterized by essentially unaffected environments in which natural ecological processes dominate, largely undisturbed by human activity (USDA Forest Service 2002b; 2002c). Specific management direction, consistent with the purposes has been developed for this RNA. The revised Forest Plan (USDA Forest Service 2002c) direction emphasizes non-manipulative research, monitoring, education, and the maintenance of natural diversity, allowing natural physical and biological processes to prevail without human intervention. Recreation uses that interfere with the purpose of the RNA may be restricted. No roads, trails, fences, or signs are allowed unless they contribute to the objectives or the protection of the RNA. Locatable minerals are "conditional", the activity is allowed as long as it is consistent with the management intent, standards and guidelines as stated in the Forest Plan. RNA's may be withdrawn from mineral entry for locatable minerals, subject to the establishment of valid existing rights, and mineral activities may be limited, modified, or restricted to maintain to the extent possible, the natural values of the area. Refer to pages 4-30 to 4-33 of the Forest Plan for more information.

**ANILCA 501(b)-2 prescription (213)** - This prescription was developed to address the "Management of Fish and Wildlife Habitat" and "Natural Quiet" interests. This theme

emphasizes the conservation of fish and wildlife and their habitats, while providing opportunities for backcountry recreational activities in a natural appearing landscape. The desired future condition is that ecological processes, largely unaffected by human activity, dominate the area. Vegetation will be mostly late successional unless regenerated by resource projects or natural processes. Projects to restore or enhance fish and wildlife habitat or other multiple use activities may be allowed if consistent with the conservation of fish and wildlife or their habitats (USDA Forest Service 2002c). Both Locatable and Salable minerals are “conditional”, the activity is allowed as long as it is consistent with the management intent, standards and guidelines as stated in the Forest Plan. Refer to pages 4-37 to 4-39 of the Forest Plan for more information.

## Chapter 2 – Analysis Area Description

### *Physical Characteristics*

#### **Climate**

The East Prince William Sound area has a maritime climate with mild temperatures and heavy precipitation, and conditions vary considerably with elevation and location. Weather records are available for the nearby weather stations known as *Cordova North* (just south of the southern boundary of the analysis area), *Valdez* (just north of the northwestern corner of the analysis area), and *Thompson Pass* (about 15 miles north of the National Forest boundary) (Western Regional Climate Center, WRCC, 2007) (Fig. 2.1, Table 2.1). The average daily temperature in the analysis area ranges from about 39 to 42°F at sea level to 28°F at 2500 feet at Thompson Pass (Table 2.1) (WRCC 2007). Temperatures decrease dramatically with increasing elevation. The Gulf of Alaska moderates temperatures along the coast, resulting in warmer minimum winter temperatures and cooler maximum summer temperatures than inland areas.

**Table 2.1 - Climate summary for weather stations near the analysis area.**

		<b>Cordova North Station #502173</b>	<b>Valdez WSO Station #509686</b>	<b>Thompson Pass Station #509146</b>
<b>Location</b>	Elevation (ft)	20	20	2500
	Latitude	60°33'	61°08'	61°08'
	Longitude	145°46'	146°21'	145°45'
	# of years of data	40	40	22
<b>Temp</b>	Average Daily Temp (F)	41.9	38.6	28.1
	Average Max July Temp (F)	61.5	62.6	57.7
	Average Min Jan Temp (F)	24.9	18.0	-0.7
<b>Precip</b>	Average Annual Precip (in)	162.5	66.3	77.3
	Average Annual Snowfall (in)	101.4	293.6	551.5
	Average Jan snowpack depth (in)	11	31	no data
	Average March snowpack depth (in)	13	43	no data
<i>Weather Station data from Western Regional Climate Center (2007)</i>				

Low pressure storms generally circulate counterclockwise in the Gulf of Alaska, with weather and winds generally come from the southeast. Precipitation increases dramatically with elevation, as the Chugach Range captures moisture from these storms. Mean annual precipitation varies, with the most occurring near Cordova and along the coast (Fig. 2.1). Inland areas are more protected from storms, so the least precipitation falls in the northern



portion of the analysis area near Valdez. Some high elevation areas in the Chugach Range receive over 200 inches of precipitation, and glaciers are typically present in these areas. The heaviest rainfall generally occurs in the late summer and fall, and the lowest rainfall occurs in the spring and early summer (WRCC 2007).

Snow falls at all elevations of the analysis area between mid-October and mid-May, although rain can occur at any time of the year. Annual snowfall ranges from about 100 to over 500 inches, depending on elevations, annual precipitation, and temperatures. The low elevation areas of the analysis area receive about 100 to 300 inches of snow annually, with maximum snowpacks generally ranging from 1 to 4 feet (WRCC 2007). With its colder temperatures, Valdez has deeper snowpacks than Cordova. Snowfall and snowpack increase dramatically with elevation, and the percentage of the total precipitation as snowfall increases from less than 20% at sea level to over 50% at elevations above 4000 feet.

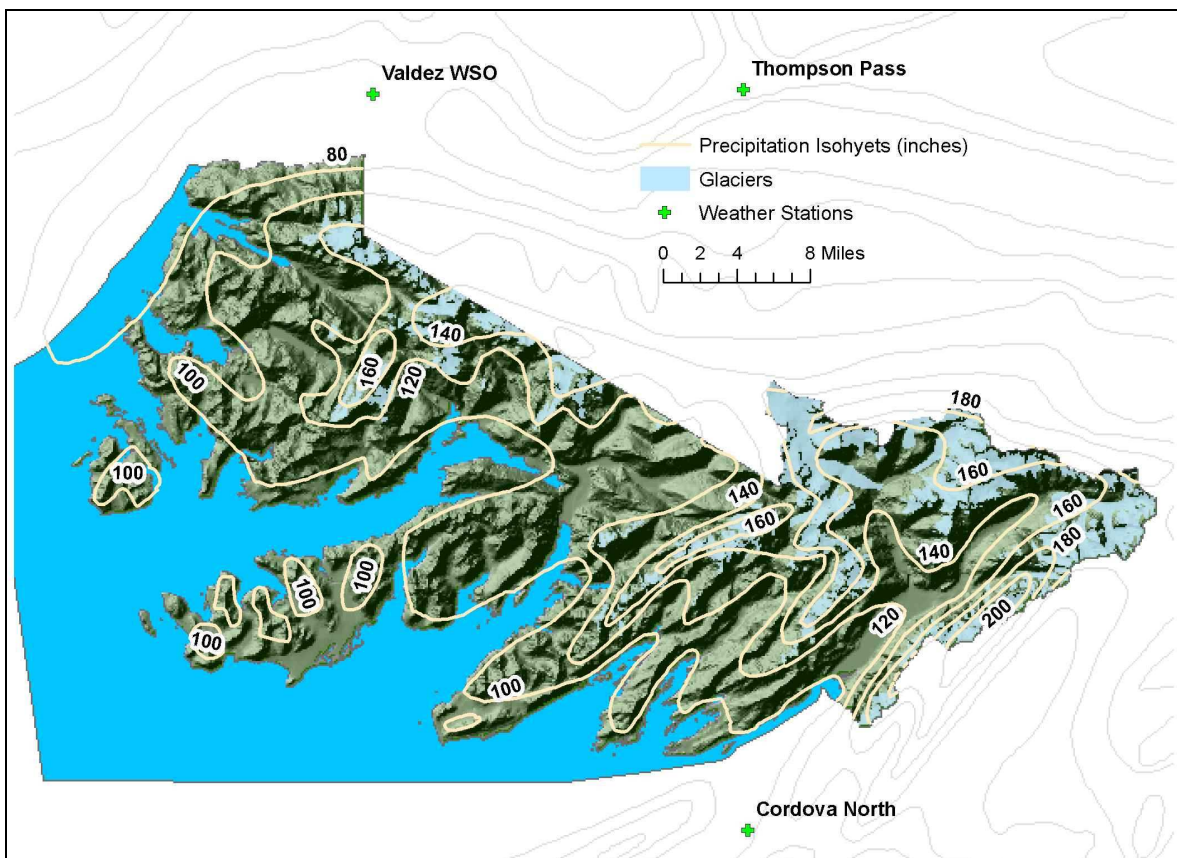


Figure 2.1 - Weather stations and mean annual precipitation, in inches, for the East Prince William Sound analysis area. Precipitation data is from USDA FS.

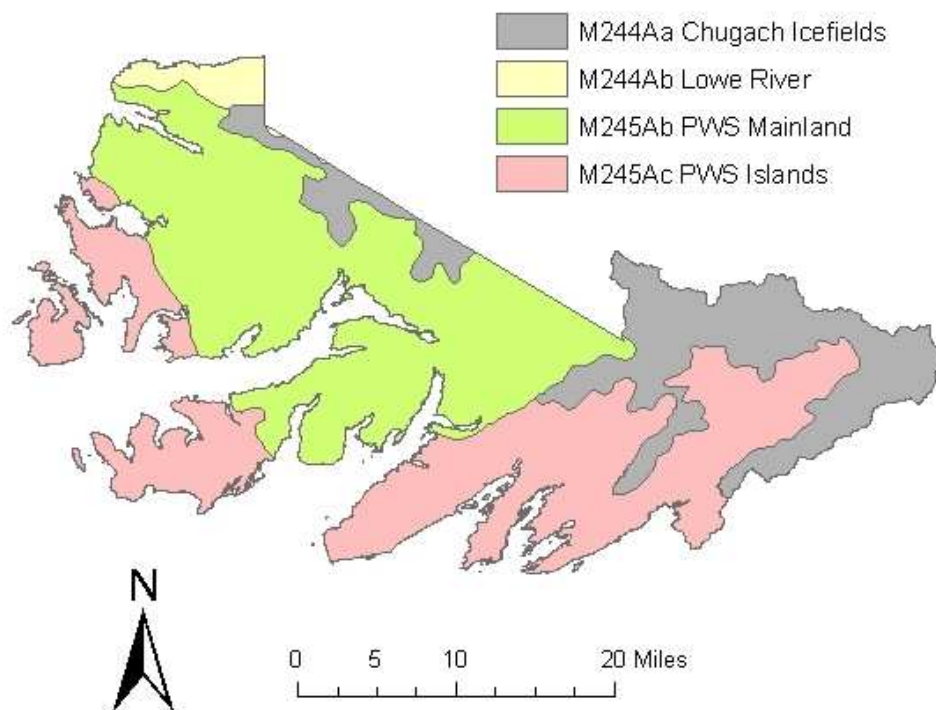
### Ecological Classification

Using the National Hierarchy of Ecological Units (USDA Forest Service 1993), the analysis area falls within the Chugach Mountains and Northern Gulf Fjordlands ecological sections as described and mapped by Davidson (1996).



In this area, the Chugach Mountains Section includes the Chugach Icefields and Lowe River ecological subsections (Fig. 2.2). A total of 108,445 acres (21% of the land area) of the analysis area is within the Chugach Icefields subsection. This subsection includes icefields, glaciers, and rugged mountains of the highest elevations of the analysis area and is characterized by high precipitation and large winter snowpacks. Only 12,257 acres (2% of the land area) of the Lowe River subsection is within the analysis area.

The Northern Gulf Fjordlands Section is divided into the Prince William Sound Mainland and Prince William Sound Islands subsections (Fig. 2.2). A total of 215,453 acres (41% of the land area) lie within the Prince William Sound Mainland subsection. This subsection includes the lower non-ice covered, steep, and rugged, mountains of the analysis area. The temperatures are sufficiently cooler such that snowpacks remain present for up to a month longer than in the Islands subsection. The Prince William Sound Islands subsection covers 192,501 acres (36% of the land area) of the analysis area. It is characterized by steep, rugged islands and lower elevation mainland areas.



**Figure 2.2 – Ecological subsections of the East Prince William Sound landscape analysis area. Data clipped from the USDA Forest Service (1997) “Ecosections” data theme.**

### **Geomorphology**

The East Prince William Sound analysis area was mainly shaped by past glacial activity. Extensive glaciation occurred in the late Pleistocene (12,000 to 25,000 years ago). Most of the analysis area, including Prince William Sound, was covered by thousands of feet of ice during this time. Rapid melting occurred in the Holocene, beginning 12,000 years ago, accompanied by numerous episodes of small advances and retreats. Since the last small-

scale glacial advance during the “Little Ice Age” over 100 years ago, glaciers in the analysis area have been receding and thinning.

The wide glacial valleys of the Rude and Gravina Rivers were formed by large valley glaciers, and expansive glaciers filled the majority of Prince William Sound. Fluvial erosion has occurred since then, forming the morphology of many of the smaller lowland and coastal drainages.

Glaciers currently cover about 71,000 acres, or 13% of the analysis area. Tidewater glaciers do not exist in this area. Most of the glaciers are in the Rude River watershed (Fig 2.3), including the Cordova Glacier and its associated icefields that continue northward into the Chugach Range and the Tasnuna River watershed. Additional small glaciers and glacial remnants exist in the higher elevations of the Gravina River, Port Fidalgo, and Port Valdez watersheds. The coastal peninsulas, foothills, and islands that make up the majority of the watershed are primarily non-glaciated.



**Figure 2.3 – Looking up the Rude River drainage, photo taken August 2007.**

Rude Lake was a 0.5-square mile glacially dammed lake historically formed by the Cordova Glacier. Past outburst floods drained into the Rude River (Post and Mayo 1971). However, these glacial outburst floods no longer occur, as the glacier has receded and no longer dams the Rude River valley into which it flows. No other large glacial outburst systems are known in the analysis area (Post and Mayo 1971).

Prince William Sound is in a state of tectonic uplift. Most recently, the area was uplifted between 2 and 6 feet during the 1964 earthquake. Flat, uplifted beach landforms from repeated uplift are visible on the Knowles Head peninsula. These landforms are presently covered by muskegs over glacial and beach deposits.

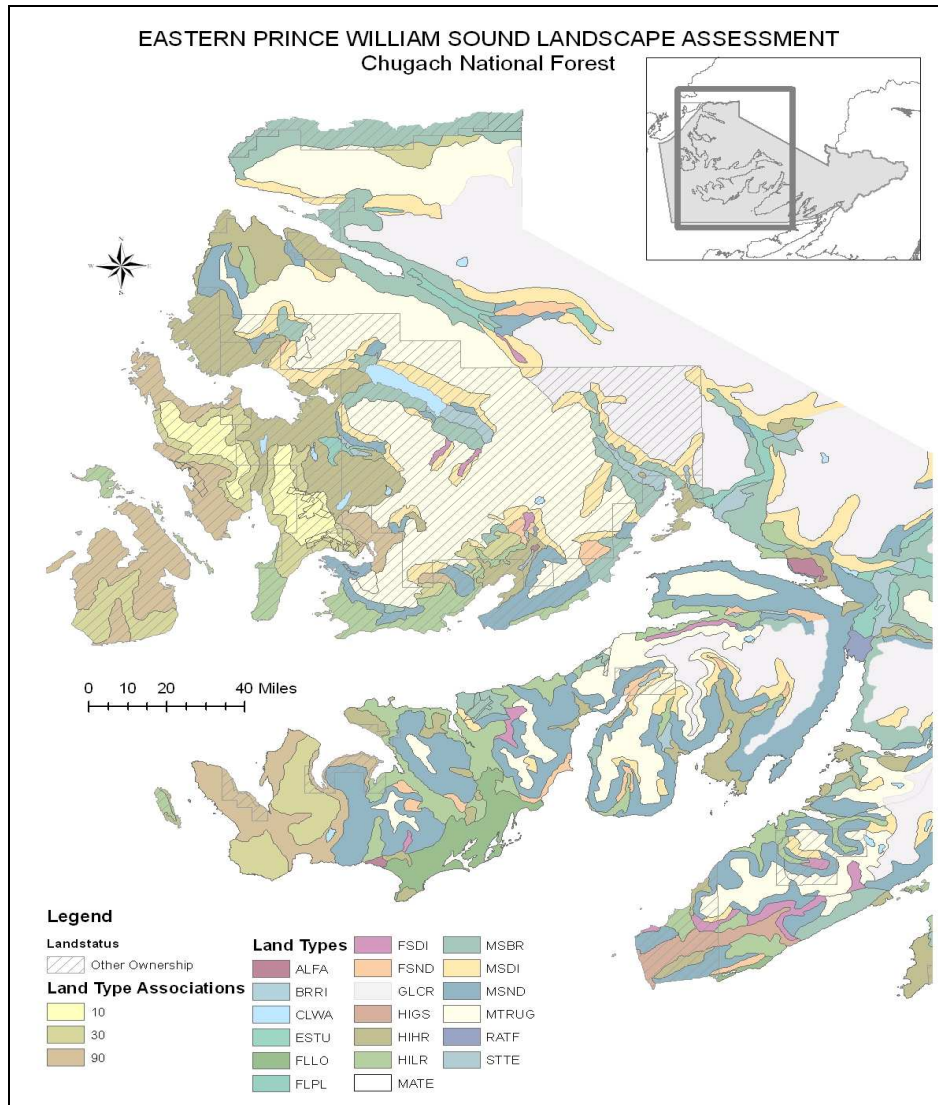
## Landtype Associations

Landtype Associations (LTA) and Landtypes (LT) are part of the National Hierarchal Framework used to delineate landscapes. Ecological units at this level are defined by the “geomorphic process and how it affects the topography, surficial geology, local climate, soils, and potential natural plants community patterns” (Davidson 1997). Soils in the analysis area can be described in terms of where they lie on the landscape because the geomorphic processes that formed the landtypes are intricately related to the pedogenic processes that form the soil on those sites (USDA Soil Conservation Service 1993). Table 2.2 and Figures 2.4 and 2.5 display the distribution of landtype associations and landtypes in the analysis area. A description of each follows the table.

<b>Table 2.2 - Acreage of Landtype Associations and Landtypes in the analysis area.</b>	
<b>Landtype Association (LTA)</b>	<b>Acres</b>
Mountain Summits (10)	4,901
Mountain Sideslopes (30)	13,381
Hills (90)	16,709
<b>Subtotal</b>	<b>34,991</b>
<b>Landtype (LT)</b>	<b>Acres</b>
Alluvial Fans (ALFA)	504
Braided Rivers (BRRI)	2,806
Clear Water (CLWA)	1,881
Estuaries (ESTU)	490
Flat Lowlands (FLLO)	4,448
Flood Plains (FLPL)	12,864
Footslopes, disturbed (FSDI)	3,538
Footslopes, nondisturbed (FSND)	3,345
Glaciers (GLAC)	174,450
Hills, gentle slopes (HIGS)	2,186
Hills, high relief (HIHR)	31,533
Hills, low relief (HILR)	20,160
Marine Terraces (MATE)	309,551
Mountain Sideslopes, Broken (MSBR)	40,625
Mountain Sideslopes, Disturbed (MSDI)	43,426
Mountain Sideslopes, Non-disturbed (MSND)	53,928
Mountain Summits, Rugged (MTRUG)	91,633
Raised Tidal Flats (RATF)	549
Stream Terraces (STTE)	4,618
No Data	62
<b>Subtotal</b>	<b>802,617</b>
<b>Total</b>	<b>837,608</b>

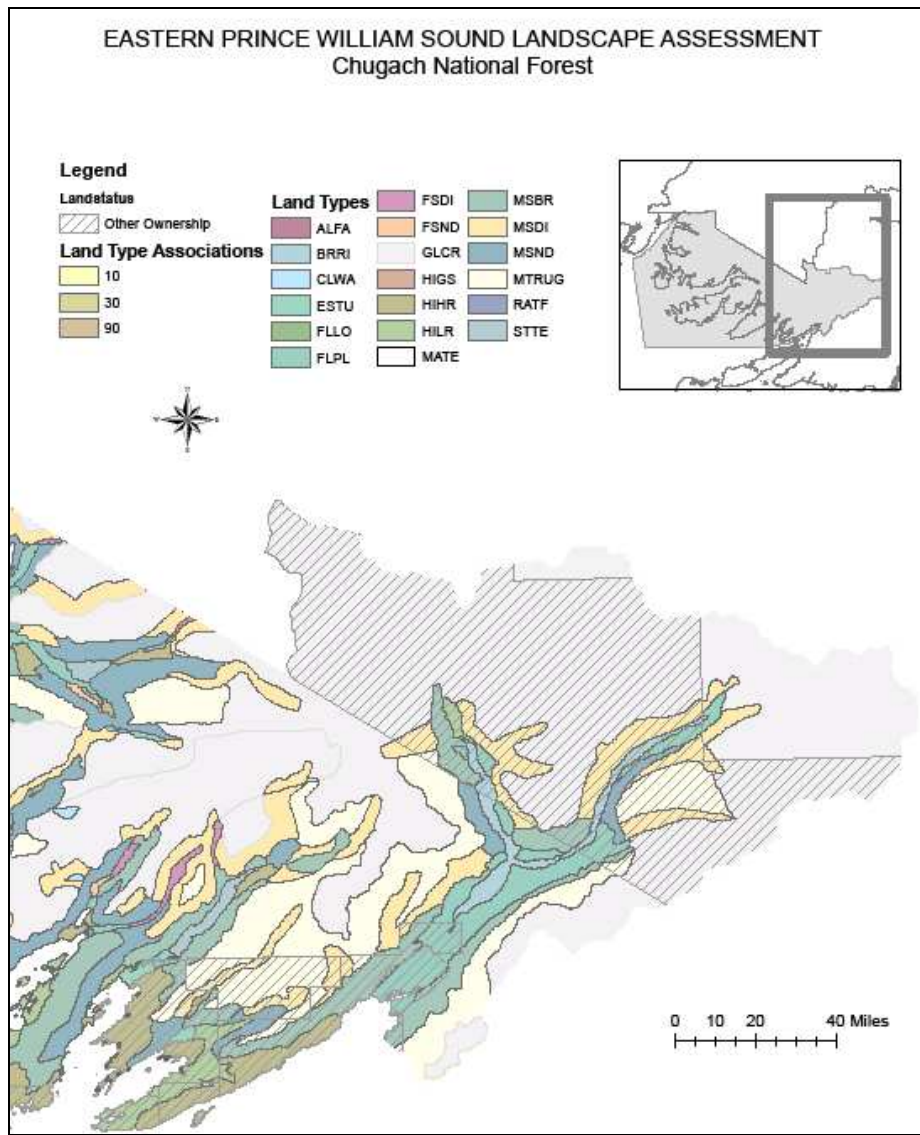
Native corporation land and former Native corporation land in the analysis area are generally differentiated at the LTA level, a coarser level of mapping than landtype. Landtype Association scale is typically mapped at 0.5 inch to 1 inch/mile scale, with map units ranging from 1 to 25 square miles (Land System Inventory, USDA, FS, 1976; ECOMAP, 1993). It is common practice to identify lands with differing jurisdictions or

ownerships at a coarser scale than National Forest System lands. Landtypes are typically mapped in a 1.0 inch to 2.64 inches/mile range, with map units ranging from 0.1 to 2.0 mi<sup>2</sup>.



**Figure 2.4 - Landtype Associations for the western portion of the analysis area.**





**Figure 2.5 - Landtype Associations for the eastern portion of the analysis area.**

**Mountain Summits (10)** - This association includes the ridges, peaks, cirque headwalls and basins and the associated scree slopes. Glaciation has been the most dominant historical geomorphic force that shaped the landscape. Frost fracturing has resulted in some cases rounded mountaintops and ridges cover by a layer of loose rock. Most of the water runs off the surface where bedrock is exposed or beneath the surface where significant depths of loose rock have accumulated. The vegetation is mostly low growing forbs, grasses, and lichens where there is sufficient soil, and some willows and other woody plants in localized wet areas.

**Mountain Sideslopes (30)** - This association includes sideslopes, glaciated or non-glaciated, smooth or irregular, that normally receive surface or subsurface water draining from alpine landscapes. Slope steepness normally ranges from 15 to 70%. The most dominant process shaping the steeper slopes in this category is erosion and transportation of sediment down slope due to gravity. Erosion from surface water usually results in a parallel drainage pattern

with V-notched channels of variable depths and densities. Soil and rock loosened by frost and water rolls down the slopes or is carried down by avalanches. This material is deposited on the lower, less steep slopes. The soils are normally medium textured, well drained, and moderately to well developed. Some of these soils on the lower slopes consist of compact glacial till which is more poorly drained and less productive for forests than other soils in the association. The upper sideslopes are commonly vegetated with low growing subalpine plants which grade into mixed communities of grasses, shrubs, and trees on the lower slopes. The location of trees is strongly dependent on disturbance by avalanches.

**Hills (90)** - This association includes hills and plateaus that do not receive surface or subsurface water flow from adjacent uplands. This excludes major rivers or creeks that may flow through the hills that originate from other areas. The surface character of these landscapes is often controlled by the stratigraphy of the bedrock. A veneer of glacial till frequently covers these landscapes. The soils are normally well-drained, medium to coarse texture on the sideslopes, and poorly drained fine to medium textured and shallow in the basins or low areas between the hills. The vegetation will usually consist of forested communities on the slopes and hilltops where the soils are well drained. The vegetation in the small basins or valleys in-between the hills will commonly be associated with wet soils or wetlands.

**Alluvial Fans** - This landtype includes the fan shaped alluvial landform located at the mouth of valley streams where the slope gradient decreases resulting in the deposition of transported sediment. It is very unstable because of the constant migration of the stream channel due to the continuous deposition of sediments and high water events resulting from heavy precipitation at higher elevations at the upper portions of the contributing valley. The alluvial soil is deep, moderately to somewhat excessively drained sand, gravel, and cobbles with very high permeability. Slope gradient is usually less than 25% and external relief less than 100 vertical feet.

**Braided Rivers** - This landtype is comprised of large glacial river channels and the included mostly non-vegetated sand and gravel bars. External relief is less than 20 feet.

**Clear Water** – This landtype includes streams, lakes and ponds.

**Estuaries** - In this area, estuaries are mostly level marine landscapes, either non-vegetated or covered by emergent plants that consist of fine-grained sediments which are normally inundated by daily ocean tides. They are exposed at mean low tide; contain relief of less than 15 feet; and have slope less than 5%. They are normally the result of submergence by post-glacial rise in sea level, but may also originate locally from tectonic processes.

**Flat Lowlands** – This landtype has slope less than 5% and relief of less than 5 feet. These stable landforms may contain ponds but are not commonly associated with flooding (standing water). This unit normally consists of bedrock overlain by marine or alluvial deposits and is smooth, flat topography vegetated with wetland plant species.

**Flood Plains** - This landtype includes the broad plains susceptible to periodic spring and early summer floods from snow run off in adjacent non-glacial clear water streams. The slope gradient is less than 5%. The stream pattern is typically meandering or braided. The soils are typically young, poorly to well drained, loamy to loamy skeletal, with moderate to rapid permeability.

**Foot Slopes, Disturbed** – This landtype includes the mostly shrub, graminoid or herbaceous covered lower, concave portion of the glaciated side slopes that are the result of glacial carving and the deposition of subsequent colluvium from the above sideslopes. The average slope gradient is less than 35%. The soils are dominated by deep, well to moderately well drained, loamy skeletal textures, with rapid permeability. Some locations have more poorly drained, finer texture soils which may pond or perch ground water running off the upper slopes. The vegetation is typically a spruce/hemlock forest separated by areas of grasses and forbs with clumps of alder.

**Foot Slopes, Non-disturbed** - This landtype includes the mostly tree covered lower, concave portion of the glaciated side slopes that are the result of glacial carving and the deposition of subsequent colluvium from the above sideslopes. The average slope gradient is less than 35%. Greater than 40% of the landtype is vegetated with trees. The soils are dominated by deep, well to moderately well drained, loamy skeletal textures, with rapid permeability. There are some locations with more poorly drained, finer texture soils which may pond or perch ground water running off the upper slopes. The vegetation is typically a spruce/hemlock forest separated by spaces of grass/forbs with alder clumps.

**Glaciers** - This landtype includes those landscapes that are covered by glaciers or perennial snowfields where the only exposed ground is typically bedrock nunataks, peaks, ridges, or loose talus. The slope gradient ranges from flat to vertical with external relief from hundreds to thousands of feet. There is rarely any exposed soil or vegetation.

**Hills, Gentle Slopes** - This landtype has slope gradients between 5 and 35%, with relief less than 50 feet between hill top and depression. In undulating topography, the hills and knobs make up the minor component. The depressions are not normally filled with ponded water. Vegetation is dominated by wetland species. Undulating bedrock and soil is overlain by accumulations of peat.

**Hills, Low Relief** - This landtype includes bedrock controlled undulating hills and shallow basins, frequently formed by glaciers. The slope gradient is usually greater than 35% and external relief ranges from 50 to 200 feet. The soils range from poorly drained, moderately deep, fine to coarse loams, and organic soils in the basins to moderately well to well drained, deep, loamy to loamy skeletal soils on the slopes. Soils are formed from glacial till or ice-scoured bedrock knobs. Soil type is highly dependent on landscape position. Soils on knobs and shoulder slopes will be shallower and less developed than those on sideslopes. Soils in toe slope positions and basins where water collects will tend to develop organic soils and may support wetland vegetation.

**Hills, High Relief** - This landtype includes bedrock controlled hills of moderate relief that are characterized by longer and steeper slopes and fewer ponds than found in the Hills – Low Relief map unit. The slope gradient is usually greater than 35% and external relief ranges from 200 to 1000 feet. The soils range from moderately well to well drained, moderately deep to deep, and loamy to loamy skeletal on the slopes and organic soils in the basins. The slopes are normally dominated by spruce/hemlock forest types and the low basins with low shrub, wetland sedges and forbs.

**Marine Terraces** - These level, tectonically uplifted, non-vegetated areas are inundated by salt water and adjacent to islands. They are generally jagged bedrock recently lifted above the effects of the surf. The external relief is generally less than 25 feet and slope gradient is less than 25%. It is bedrock buttresses or scarps adjacent to the ocean with deeply incised stream channels.

**Mountain Sideslopes, Broken** - This landtype includes the long sideslopes that occur below alpine landscapes where the parallel drainage pattern is broken by bedrock benches or knobs. These slopes may or may not be frequented by avalanches, rock falls, etc. The slope gradient is greater than 65% except on the benches or knobs where the slope may be less than 35%. External relief is usually greater than 1000 feet. The soils range from shallow on the upper slopes to deep on the lower slopes and are typically well drained, loamy to loamy-skeletal, with moderate to rapid permeability. The vegetation ranges from subalpine forbs, grasses and shrubs to well developed spruce/hemlock forests on the lower protected slopes.

**Mountain Sideslopes, Disturbed** - This unit located below alpine landscapes includes the long sideslopes of high relief dominated by rock fall, slides, and avalanches. The slope gradient ranges from 35 to 75%, and the external relief is greater than 1000 feet. Greater than 40% of this mapping unit is dominated by avalanches and slides. The soils range from moderately deep on the upper slopes to deep on the lower slopes and are well drained, loamy to loamy-skeletal, with moderate to rapid permeability. The vegetation consists of shrubs, grasses and forbs in areas of frequent slides and mature spruce/hemlock forests in areas protected from slides.

**Mountain Sideslopes, Non-disturbed** - This mapping unit includes the long sideslopes of high relief that occur below alpine landscapes that are not dominated by rock fall, slides, and avalanches. The slope gradient ranges from 35 to 75%, and the external relief is greater than 1000 feet. Less than 40% of this mapping unit is dominated by avalanches and slides. The soils range from moderately deep on the upper slopes to deep on the lower slopes and are well drained, loamy to loamy-skeletal, with moderate to rapid permeability. The vegetation consists of shrubs, grasses, and forbs in areas of frequent slides and mature spruce/hemlock forests in areas protected from slides.

**Mountains, Rugged** - This mapping unit includes the jagged rocky ridges, peaks, associated sideslopes, cirque basins, headwalls, and rock glaciers that are the result of past or present alpine glaciations and frost wedging and weathering. It does not include glaciers or perennial snow fields greater than 40 acres. The slope gradient is usually greater than 65% and the internal relief is greater than 100 feet. Exposed bedrock and unvegetated talus



comprise greater than 50% of the mapping unit. The soils are shallow, well drained, loamy or sandy skeletal, with rapid permeability. The vegetation is typically sparse, consisting of low grasses, sedges, forbs, and shrubs.

**Mountain Summits** - These areas occur at higher elevations and are characterized by rocky terrain with intermittent ice and snow. The soil tends to be stony, weakly developed and shallow. Subtle changes in the soil profile and depth occurs as one moves from concave to convex positions on the landscape.

**Raised Tidal Flats** - This landtype is vegetated marine delta that has been tectonically uplifted and is no longer exposed to tidal activity. It is restricted to large marine deltas that are normally characterized by incised slough channels and shallower ponds. Slope gradients are 0 to 5% with internal relief of less than 10 feet and external relief less than 15 feet.

**Stream Terraces** - This landtype includes the river terraces present in valleys where rivers have eroded incised channels in previously deposited alluvium. The terraces have sufficient relief to not be affected by floods or annual fluctuations of the water table or adjacent streams. The soils consist of well drained, deep, alluvial sands, gravels, and cobbles. Upper slope gradient is less than 5% while the adjacent water cut slopes may be up to 65%. External relief is normally less than 15%. The vegetation consists of early successional species such as alder, cottonwood, willow, grasses, and other herbaceous plants.

## **Geology**

The predominate bedrock of the southern half of the analysis area is primarily undivided sedimentary rocks of the Cretaceous Valdez Group, a thick sequence of deformed interbedded metasedimentary and metavolcanic rocks. This group is part of a belt of Cretaceous marine rocks 1000 miles long and as much as 60 miles wide that extends along the Gulf of Alaska margin from Chatham Strait in southeastern Alaska to Kodiak and Shumagin Islands in southwestern Alaska. The Valdez Group is part of the Chugach Terrane as defined by Dumoulin (1972). These rocks typically include sandstone, siltstone, argillite, slate and phyllite. The entire sequence is folded and deformed and metamorphosed to grades ranging from zeolite to amphibolite facies.

The Bagley Fault to the east and the Gravina Fault to the west, transect Orca Group rocks to the south from Valdez Group rocks to north in the analysis area. The Orca Group is part of an accretionary belt of Paleocene age rocks called the Prince William Terrane that extends across Prince William Sound westward through the Kodiak Island area, underlying much of the continental shelf to the west.

**Valdez Group Types:** Four Late Cretaceous types occur in the analysis area (Fig. 2.6). The most abundant unit is *Kvs*, a thick sequence of sedimentary rock consisting of sandstone, siltstone, argillite, slate, phyllite, and rare beds of pebbly argillite. Layers are generally a few inches to a few feet thick, but massive sandstone as much as several tens of feet thick is locally present. Valdez Group rocks are limited to the northern portions of the analysis area and are most abundant between Valdez Arm and Fidalgo Bay.

Minor exposures of the *Kvvs* unit, consisting of interbedded volcanic and sedimentary rock, are scattered throughout the analysis area and in an east-west band near Cordova Peak.

One small outcrop of the *kvu* ultramafic rock unit is present near the northeast Forest boundary. Small linear bands of the *Kvgr* unit are also present in the analysis area, along the northeastern boundary near the heads of Woodworth and Schwan Glaciers and in the northwest near Jack Bay. Rocks of this unit consist of massive greenstone, metamorphosed pillow basalt, and mafic dikes.

**Orca Group Types:** The five Orca Group types present in the analysis area are *Tos*, *Toc*, *Tosv*, *Top*, and *Tops*. The *Tos* unit is a sedimentary unit of the Orca Group which makes up a monotonous sequence of thin- to thick-bedded sandstone, siltstone, and mudstone showing abundant sedimentary structures indicative of deposition from turbidity currents. Orca Group rocks crop out along a broad band, sweeping from east to west across the southern half of the analysis area. Sandstone is more abundant than finer-grained rocks. Minor amounts of hemipelagic<sup>1</sup> mudstone occur throughout the Orca Group. Limestone lenses or concretions are found locally, and these, along with conglomerates, are characteristic of sedimentary rocks belonging to the Orca Group.

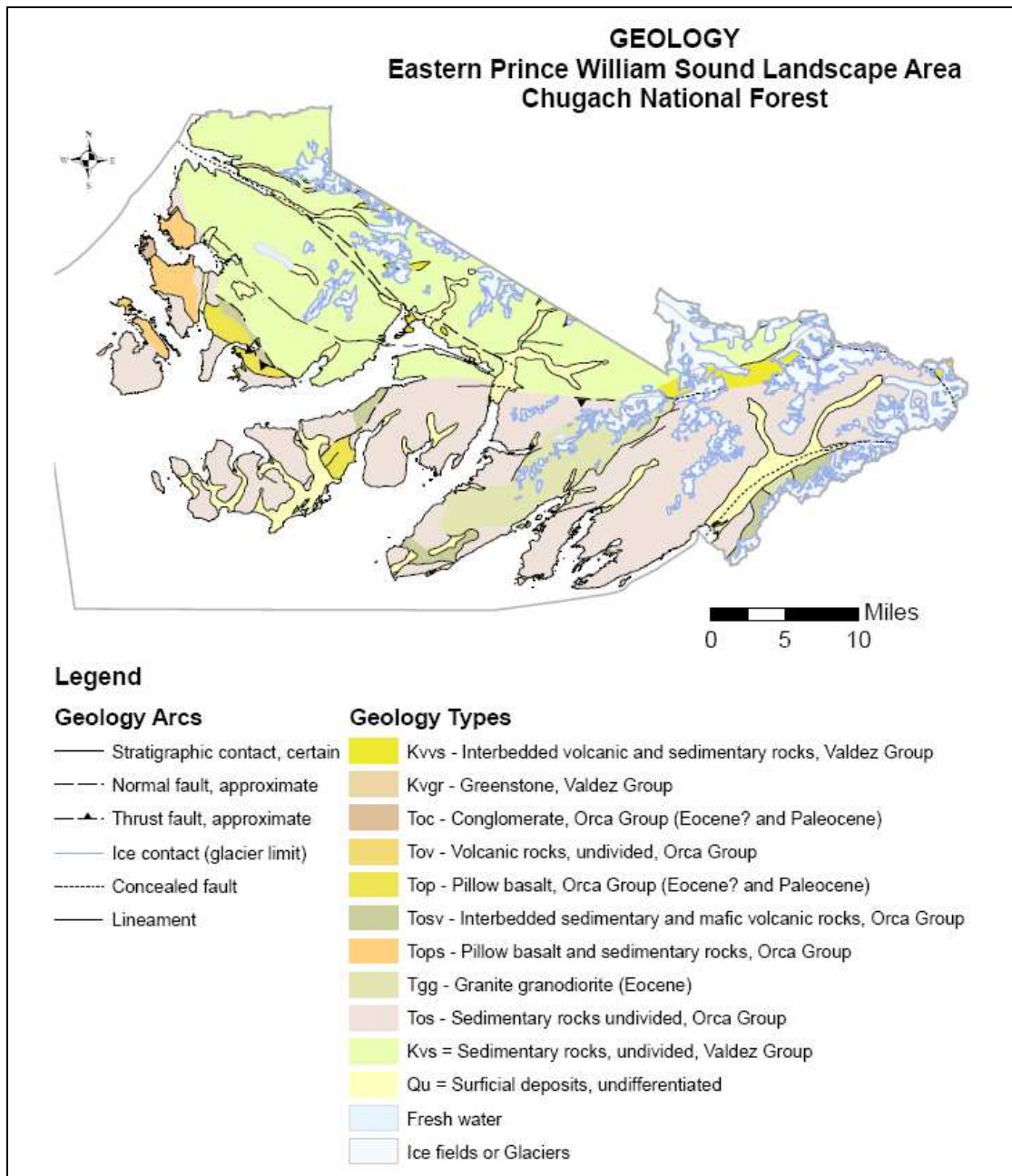
Minor outcroppings of the *Top*, *Tops* and *Toc* units occur in the analysis area. The *Top* unit, composed of pillow basalts, is exposed both north and south of Fidalgo Bay and the *Tops* unit, composed of pillow basalts and sedimentary rock, is confined to outcroppings on the northeast end of Bligh Island and Galena Bay north of Tatitlek. An isolated outcropping of the *Toc* unit which consists of conglomerate occurs at Rocky Point north of Tatitlek and a second, very small outcrop occurs north of Galena Bay. The greenstone belt unit, *Tosv*, occurs as small outcrops across the central and south portions of the analysis area. This unit is interbedded sedimentary and mafic volcanic rock with variable portions of interbedded turbidites and basalt.

**Eocene-age Unit:** Exposures of the granite and granodiorite unit, *Tgg*, occurs in the analysis area between Gravina and Sheep Bay and in the Rude River drainage. The exposed plutons form the ridge between Gravina and Sheep Bay.

**Quaternary deposits:** The *Qu* unit consists of undifferentiated, unconsolidated surficial deposits left by glacial melt water and alluvium from non-glacial streams. They are recent deposits composed entirely of clastic material (clay, silt, sand, gravel, and talus). This unit occurs in lowlands, valley floors, and along river and creek bottoms.

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<sup>1</sup> Sharing deep sea and shallow sea characteristics.



**Figure 2.6 - Geology of the East Prince William Sound analysis area. USDA FS, 1996-2000. Chugach NF Corporate GIS Data Layers.**

## Soils

This area has been shaped extensively by numerous glaciers over the last couple of million years. Many of the upper sideslopes and uplands are in the early stages of soil development, which is severely limited by the harsh climate. The soils on the lower sideslopes and the valley bottoms are also young and formed by the recent recession of the glaciers and subsequent exposure of the gravels and dirt to soil developing processes. The sideslopes tend to be underlain by compact glacial till, which can restrict water movement and is able to support wetlands and associated hydric soils. The bedrock lithology can be the primary

influence on soil characteristics in areas not overlain by colluvium, alluvium, or glacial deposits. It will also result in soils with properties different from those in alluvial soils. In areas where geomorphic characteristics restrict water movement, their influence on soils will be indirect by creating anaerobic conditions that support the formation of organic soils.

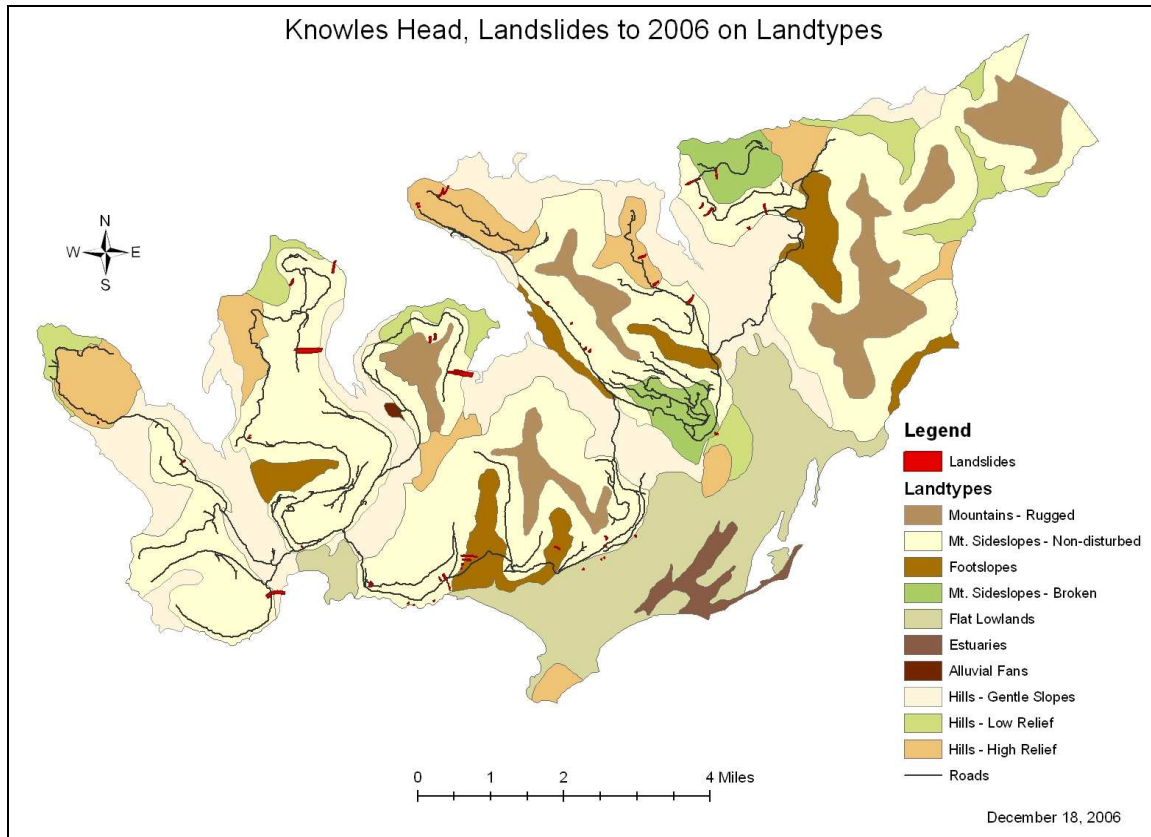
The three ways soil and landform characteristics are measured relative to impacts from various management activities are soil productivity, erosion potential, and mass movements. Soil productivity is measured by the thickness of the surface soil organic layer and the amount and type of vegetation supported on the soil. The decomposition which makes nutrients available for plant growth occurs in this layer. Other factors common to the more productive sites include soils that are at least moderately deep and well drained. These soils usually produce stands of large trees.

Soils become less productive with thinner organic surface layers, poorer drainage, shallower depths or where they have disturbance site characteristics such as avalanches, bedrock outcrops, or landslides. These soils will most often be vegetated with shrubs and herbaceous species. Some soils are located on active floodplains where continual erosion will likely erode them prior to vegetative development. Other soils have low productivity due to poor drainage or saturation by water. They are normally vegetated with herbaceous and hydric vegetation. Alpine areas with rock outcrops, snowfields, and glaciers have a climate and other ecological conditions that are too harsh and unsuited for abundant vegetative growth; they are usually unvegetated or have minor amounts of moss or alpine vegetation.

Erosion can be looked at in terms of landslides and surface erosion. Surface erosion occurs on soils that are not sufficiently mulched on the surface with vegetative litter. This erosion is also dependent on slope, soil texture, cohesion, and exposure to wind and water. These areas are most commonly located on exposed surfaces resulting from natural or management causes, slopes recently exposed from receding glaciers, and on floodplains and terraces. Avalanches can also contribute to erosion through removal of the protective vegetative cover or the physical movement of the soil or rock. Erosion also occurs on the exposed river bars that have not yet been adequately revegetated.

The analysis area is moderately prone to slope stability sensitivity landslide hazards. Figure 2.7 displays landslides identified through aerial surveys that occurred from 1998 through 2006 in the Knowles Head area. Mapping will be updated in 2008.

There are critical slope stability factors that must be evaluated when a management activity is considered. The major factors include slope, topographic position, soil texture and mineralogy and drainage, and any subsurface restrictions that impair the flow of water. These criteria are individually rated and the total score of a particular site can be used as a relative indication of the slope stability (Appendix B). Naturally occurring landslides due to climate, steep slopes, weathering, and continuous undercutting of sideslopes by streams may occur in the study area. The potential increases as slope increases and may become serious on slopes over 72% that have had vegetation removed. They may also be accelerated where roads are constructed across slopes where soils are poorly drained, have fine texture, or have a high amorphous component.



**Figure 2.7 – Location of landslides on Knowles Head peninsula.**

## **Wetlands**

Based on the National Wetlands Inventory using the classification of Cowardin et al. (1979), wetlands cover 72,913 acres, or 14% of the analysis area (Fig. 2.8). Palustrine wetlands are the most abundant wetland system of the area covering 64,219 acres or 12% of the area. Eighty-six percent of the analysis area is upland, non-wetland habitat (455,744 acres).

Wetlands are common in the low-lying, flat, uplifted areas at the bases of the mountains on the various peninsulas that extend into the Sound. These areas are typically muskeg meadows and uplifted beach deposits. Wetlands also exist in the wide, low gradient valley floors of the larger glacial rivers, such as the Rude and Gravina Rivers. Limited wetlands are scattered throughout the higher elevation areas of the analysis area.

Palustrine wetlands cover about 64,500 acres of the analysis area (12% of the land area). These areas contain numerous channels, ponds, and beaver ponds. Riverine wetlands cover 3500 acres (0.7% of the land area) along the larger rivers draining the Chugach Range, including the Rude and Gravina Rivers. Lacustrine wetlands cover about 2000 acres (0.4% of the land area), including many small lakes and ponds in the analysis area. The largest lake in the area is the 962-acre Silver Lake in the Galena Bay drainage. Estuarine wetlands are present in the intertidal areas of Prince William Sound.

Groundwater-fed streams are common at the bases of steep sideslopes and in the upper portions of glacial outwash fans, where coarse ground material allows for subsurface flow. These springs and streams contain clear water and can provide important anadromous habitat in glacial and non-glacial systems.

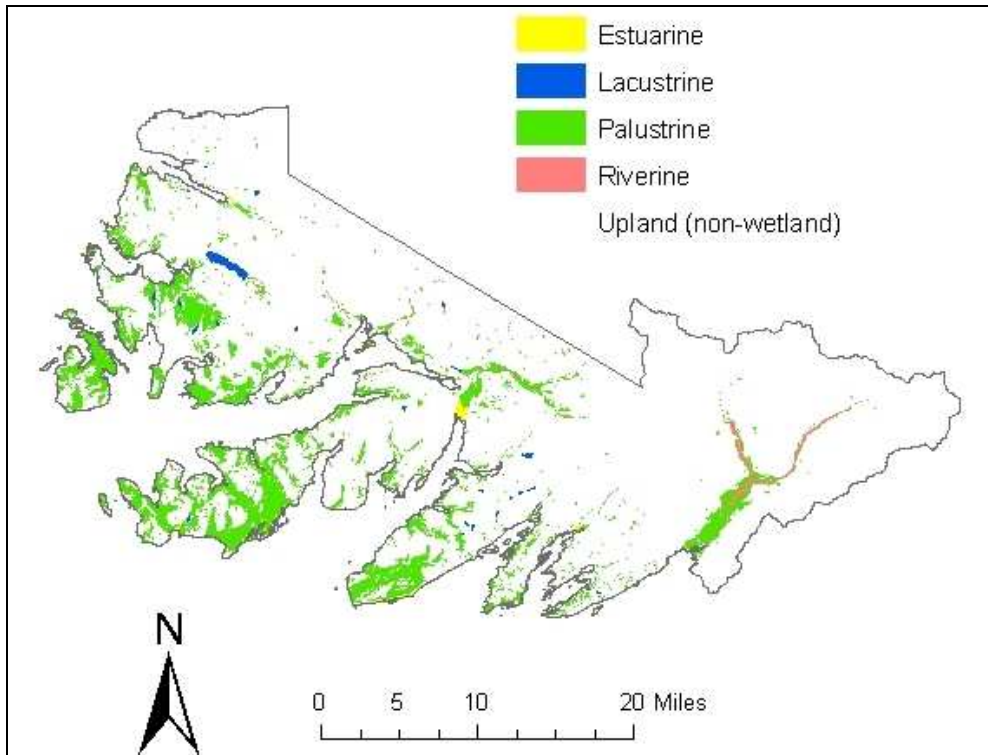
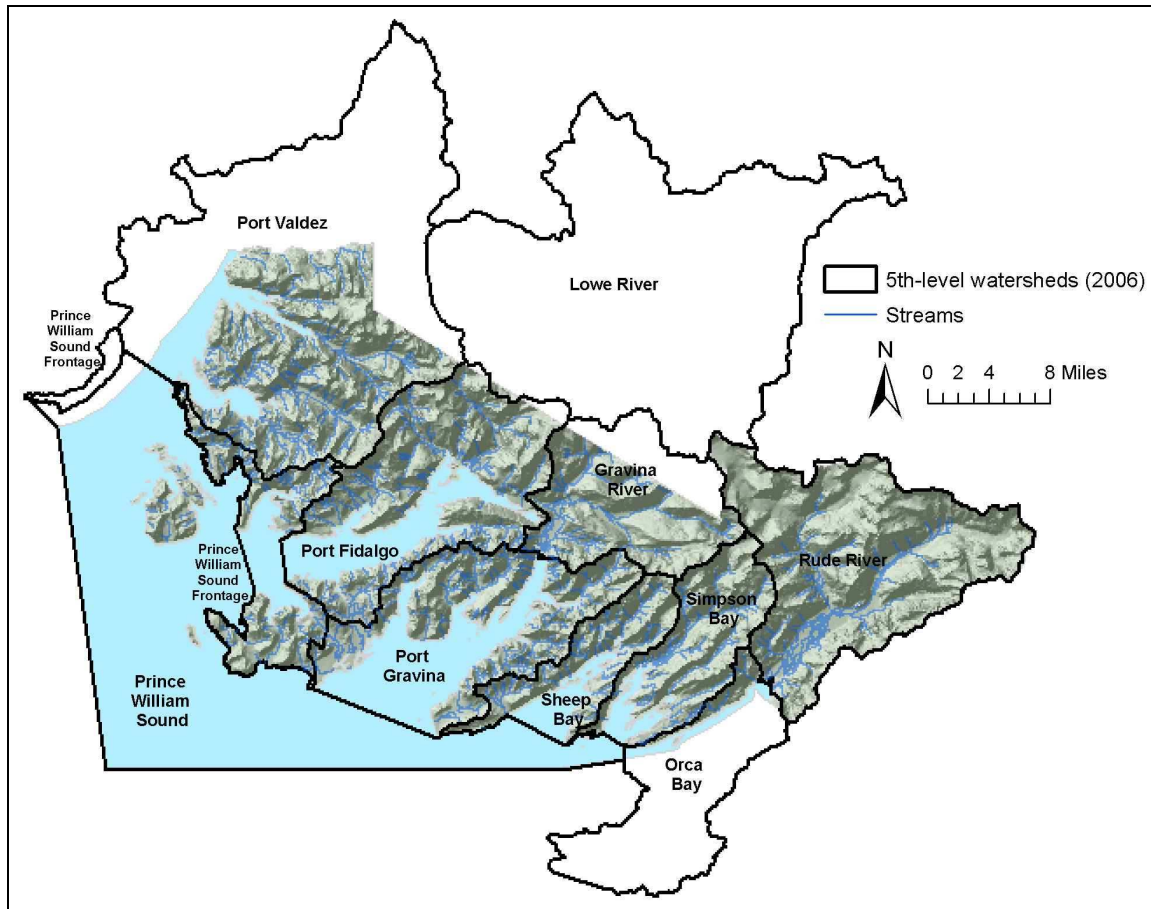


Figure 2.8 – Wetland systems of the East Prince William Sound analysis area. Data clipped from the USDA Forest Service (1997) “Wetlands” data theme.

## Hydrology

**Watershed Morphology** - The analysis area includes a variety of glacial and non-glacial watersheds draining southwest into Prince William Sound. It is defined by the boundaries of 9 “watershed associations” delineated on the Chugach National Forest. New watershed boundaries were delineated in 2004 to the 5<sup>th</sup> and 6<sup>th</sup>-levels (watersheds and sub-watersheds) following national standards (Federal Geographic Data Committee 2002) (Fig. 2.9). The analysis area lies fully or partially within 11 5<sup>th</sup>-level watersheds. All watersheds, except the Rude and Gravina Rivers, are coastal watersheds comprised of numerous small watersheds that drain into common bodies of water into Prince William Sound. The Rude and Gravina Rivers are the largest rivers in the analysis area.

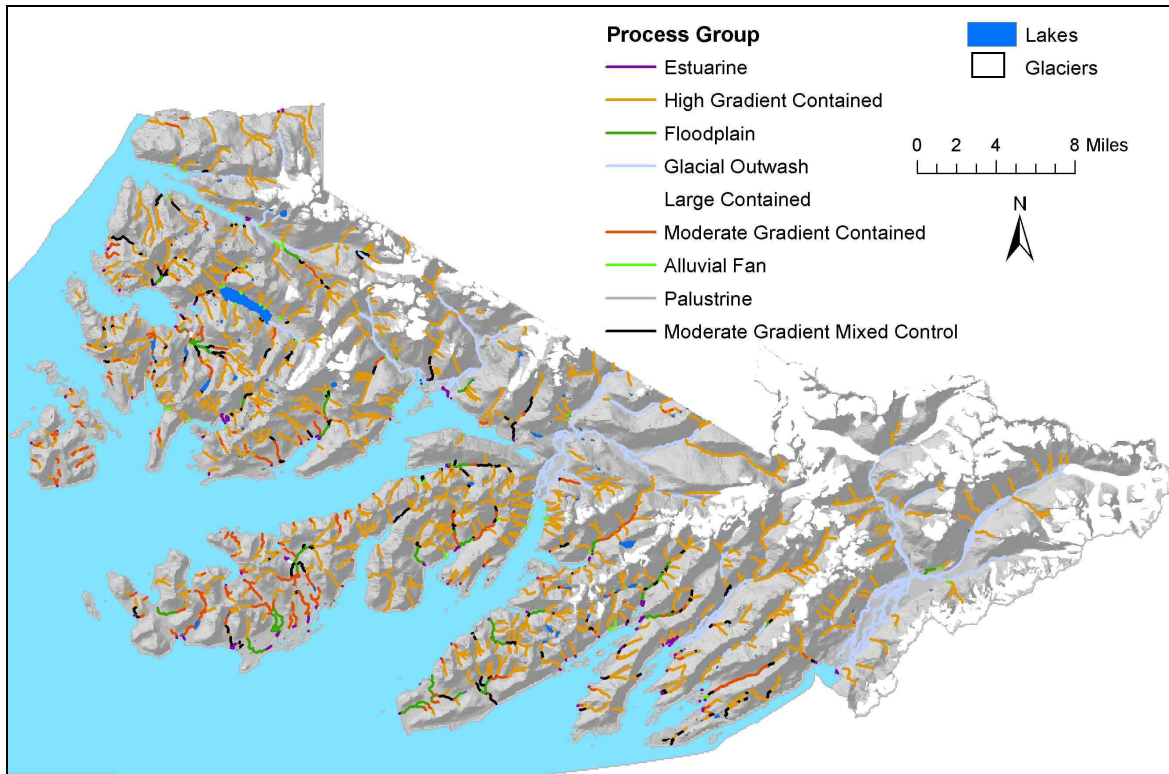




**Figure 2.9 - Watersheds of the East Prince William Sound landscape analysis area.**

**Streams** - A total of 938 miles of mapped streams and rivers lie in the analysis area, classified using the Tongass National Forest stream classification system (USDA Forest Service 1992) (Fig. 2.10). Because field verification was limited or not accomplished in much of this area, some assigned channel types may be inaccurate, and some important anadromous streams were not mapped.

About 55% of the channels in the analysis area are High Gradient Contained (HC) channels. Streams draining the peninsulas and small coastal watersheds along the Prince William Sound shoreline are predominantly short, non-glacial, high gradient channels. Glacial Outwash (GO) channels comprise about 19% of the channels in the analysis area. Glacial streams and rivers are common in the Rude River and Gravina River watersheds and less common in the small coastal watersheds. Moderate Gradient Contained (MC) and Moderate Gradient Mixed Control (MM) channels, comprising 14% of the channels, generally lie on the lower slopes of the coastal watersheds. Floodplain (FP) and Palustrine (PA) channels, comprising 6% of the channels, lie in the flat areas, muskegs, and uplifted landforms at the bases of the coastal mountains.



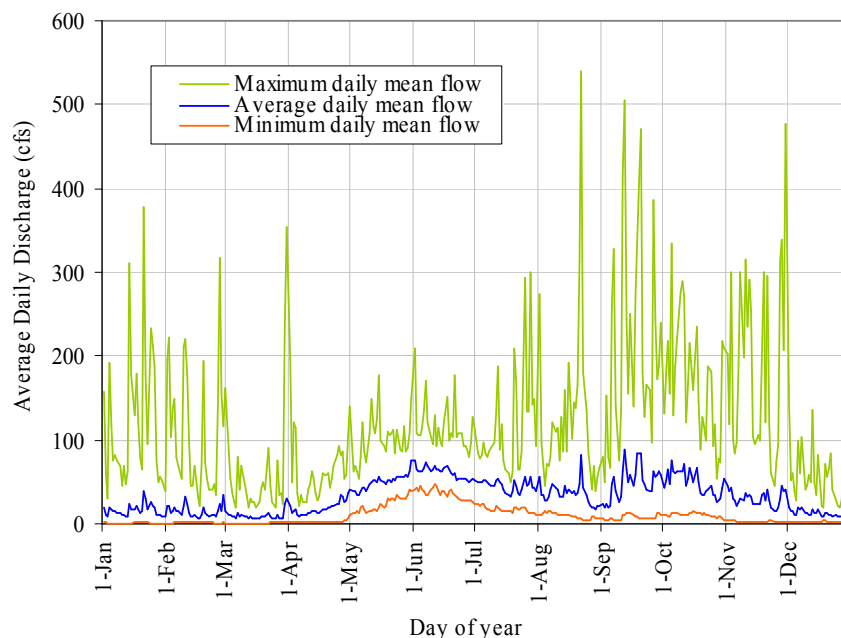
**Figure 2.10 – Stream channel type process groups in the analysis area.**

**Streamflows** - Streamflow data for streams in the Eastern Sound are limited, and no gauging stations are currently in operation. Historic data are available for the West Fork Olsen Bay Creek (16 years of daily and peak flow data) and Control Creek (11 years of peak flow data), both located on the south side of the Knowles Head Peninsula. Data from these streams can be used to approximate flows on other low or moderate elevation streams in the analysis area. However, streams in the eastern portion of the analysis area, characterized by higher precipitation and more glaciers, have different streamflow characteristics.

Streamflows in the small coastal watersheds along the lower elevation peninsulas and bays of the western portion of the analysis area are dominated by rainfall runoff, with a small component of snowmelt runoff in the spring and early summer (Table 2.3, Fig. 2.11). These small, steep watersheds can generate flashy flows that respond quickly to precipitation events. Many of the small coastal watersheds have runoff characteristics similar to those in West Fork Olsen Bay Creek and Control Creek. Snowmelt runoff generally begins in late April, peaking in early June. Late summer and fall rainstorms, particularly in August, September, and October, cause large peak flows and a period of elevated flows during this time. Rainstorms such as these can also occur throughout the winter.

Streams originating in the higher elevations of the Chugach Range in the eastern portion of the analysis area are dominated by glacial runoff and snowmelt runoff. Peak flows from snowmelt tend to occur in June or July, with glacial melt extending the peak further into the summer. The higher elevation streams can also be affected by rainfall runoff, and large peak flows can occur throughout the year from rainfall.





**Figure 2.11 - Daily streamflows statistics for West Fork Olsen Bay Creek. Period of record was 9/1/1964 to 4/21/1981. Data from US Geological Survey (USGS) (2007).**

**Table 2.3 - Flow statistics for stream gauges in the analysis area (USGS 2007).**

	WF Olsen Bay Creek		Control Creek	
USGS Station Number	15219000		15219100	
Latitude	60°45'41"		60°45'00"	
Longitude	146°10'20"		146°14'00"	
# of years data	16 (1964-1981)		11 (1964-1974)	
Drainage area (sq miles)	4.8		4.22	
Average daily flow (cfs)	33		n/a	
Extreme minimum daily flow (cfs)	0.5 (3/66)		n/a	
Extreme instantaneous peak flow (cfs)	1030 (9/12/72)		1280 (9/12/72)	
Average June flow (cfs)	61		n/a	
Average March flow (cfs)	10		n/a	
2-year flood ( $Q_2$ ) (cfs)	569	(119 cfs/mi <sup>2</sup> )	556	(132 cfs/mi <sup>2</sup> )
10-year flood ( $Q_{10}$ ) (cfs)	892	(187 cfs/mi <sup>2</sup> )	967	(229 cfs/mi <sup>2</sup> )
100-year flood ( $Q_{100}$ ) (cfs)	1,300	(272 cfs/mi <sup>2</sup> )	1,590	(377 cfs/mi <sup>2</sup> )
Data from US Geological Survey (2007).				
Flood frequency statistics from Curran et al. (2003), weighted skew.				

## Water quality and sedimentation

Because of the scarcity of development and human activities in the analysis area, water quality is generally pristine. The US Geological Survey monitored water quality on West Fork Olsen Bay Creek from 1970 to 1979 (US Geological Survey 2007). These data show conditions of clear, cold, well oxygenated water. Additional water quality data for streams in the analysis area are scarce.

Streams influenced by glaciers in the analysis area are considerably more turbid than non-glacial streams. These glacial systems transport large quantities of glacial silt from the active glaciers remaining in the higher elevations. Most of these systems do not have proglacial lakes to capture bedload sediment, resulting in high bedload transport rates and active channel migration on their outwash plains. The larger rivers draining the high peaks of the Chugach Range, including the Rude, Gravina, and Fidalgo Rivers, have high sediment loads and turbidities. The streams draining smaller, low elevation, coastal watersheds are primarily not influenced by glaciers and have low sediment loads.

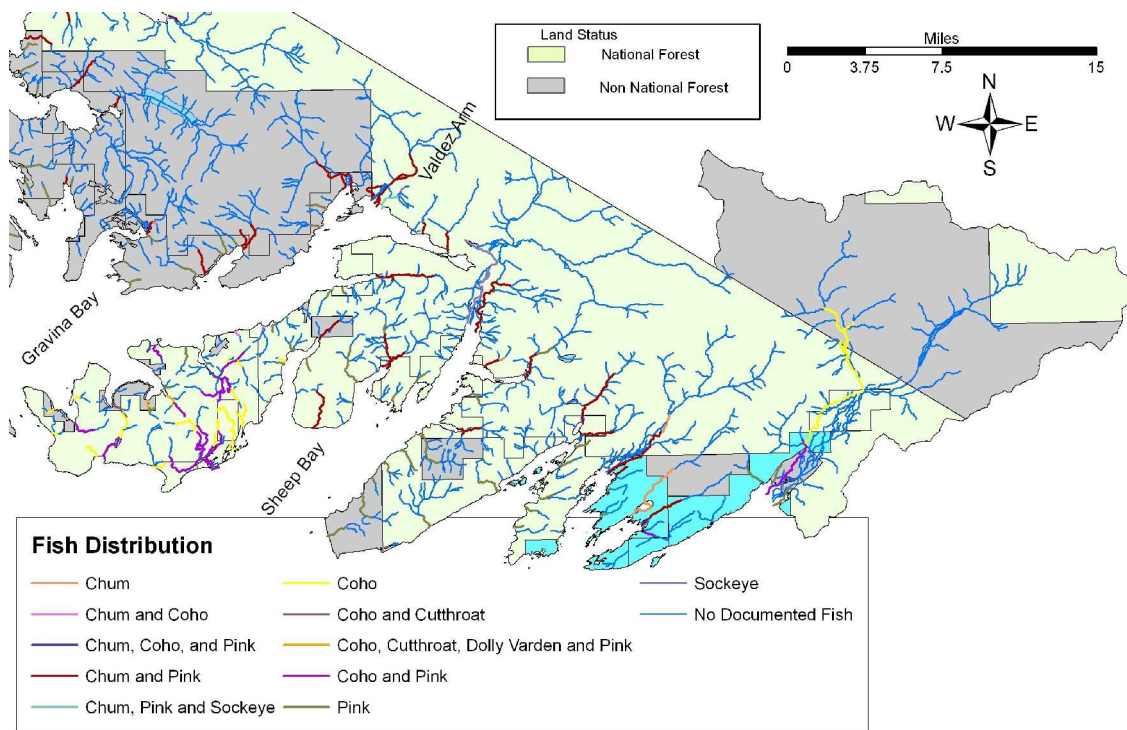
## **Biological Characteristics**

### **Fish**

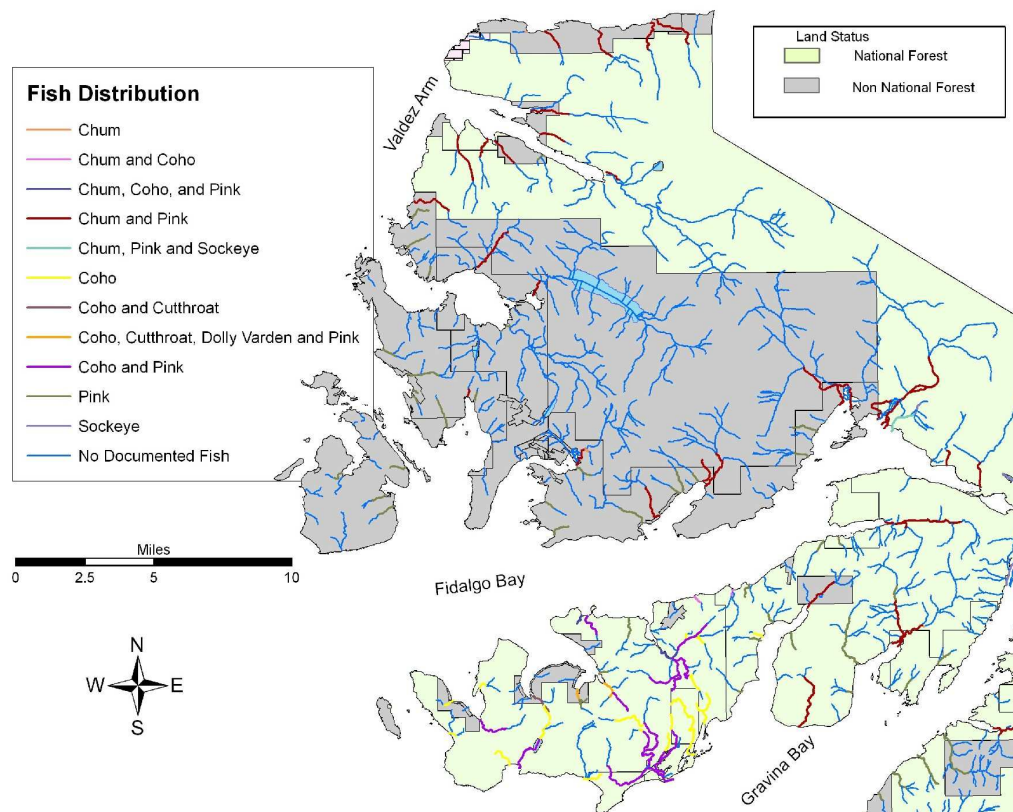
**Fish species present in the analysis area** - From the human perspective, the most important fish species in the East Prince William Sound analysis area are the Pacific salmon. These species are fished commercially as well as for sport and subsistence purposes. Pink salmon (*Oncorhynchus gorbuscha*) are found in nearly every stream, while chum salmon (*O. keta*) are the second most widespread. Coho salmon (*O. kisutch*) are found in many streams, but the adult populations are often quite small and may be undocumented. The Alaska Department of Fish and Game (ADFG) Anadromous Waters Catalog lists only four streams with sockeye salmon (*O. nerka*) and no streams with chinook salmon (*O. tshawytscha*) (ADFG Anadromous Fish Stream Viewer) (Figs. 2.12 and 2.13). Howse (1975) reported three other streams with sockeye salmon, but it is not known whether these stocks still exist or if the fish that were observed were just strays from another system.

Not as much is known about the presence of non-commercial fish species or the size of their populations. Dolly Varden (*Salvelinus malma*) are widespread and are likely to be found in most streams, although the documentation has been limited (Helle et al. 1964, Schelske et al. 1998, Lang and Jurica 2007). Cutthroat trout (*O. clarkii*) are known to be in many of the streams on the Knowles Head Peninsula (Lang and Jurica 2007) and in Milton Lake (Schelske et al. 1998), but their presence in other systems is not known due to the lack of surveys. Threespine stickleback (*Gasterosteus aculeatus*) should be found in most lowland ponds and estuarine channels, while coast range sculpin (*Cottus aleuticus*) are likely to be in rocky streams. Helle et al. (1964) reported finding coast range sculpin, Pacific staghorn sculpin (*Leptocottus armatus*), threespine stickleback, starry flounder (*Platichthys stellatus*), and Pacific tomcod (*Microgadus proximus*) in the tidally affected areas of Olsen Creek.

There are no threatened or endangered fish species in the analysis area. In the Forest Plan (USDA Forest Service 2002c), coho salmon and Dolly Varden are listed as Management Indicator Species. Changes in the populations of these species are “believed to indicate the effects of land management practices”. Cutthroat trout are listed as a Species of Special Interest because they exist in Prince William Sound in small, isolated populations at the northern extent of their range. Thus, these populations may be more sensitive to management practices, other human effects, or natural events.



**Figure 2.12 Fish distribution in eastern portion of analysis area. Data from USFS GIS database (2002).**



**Figure 2.13 -Fish distribution in western portion of analysis area. Data from USFS GIS database (2002).**

**Physical characteristics influencing fish distribution** – The fish species and their ecology are governed mainly by the landforms found in the analysis area. Generally speaking, the high gradient landforms and associated streams limit spawning and rearing habitat. The floodplain channels in low gradient areas provide the most productive fish habitat, but these channels are relatively scarce (Fig. 2.10). Given the steep terrain, most of the streams are relatively short, higher-gradient systems that do not have extensive sections of low gradient (< 2%) floodplain channel types before they reach the ocean. Even some of the larger creeks have less than a mile of low-gradient channel.

The short length of these streams affects coho salmon production the most. Juvenile coho salmon spend one or two years in fresh water before migrating to the ocean, so they are highly dependent on the amount of rearing habitat in the streams. The juveniles prefer low-gradient, low-velocity areas in pools, backwaters, ponds, and side channels where they do not have to expend much energy fighting the current, particularly in the winter when food sources are limited. Since winter survival for juvenile coho salmon can be quite low (4% to 13 % Ebersole et al. 2006, 25% Reeves et al. 1989), a stream has to have large quantities of suitable winter habitat to sustain a population. Unless a stream has a lake, beaver ponds, or extensive braids or side channels, habitat in a system only a few miles long is generally insufficient. Thus, many of the creeks in the analysis area may have coho salmon, but with only small numbers of returning adult fish. Additional information is provided in the East Prince William Sound Landscape Assessment Fisheries Resource Report prepared by Hodges (2007).

Pink and chum salmon, however, are not dependent on winter rearing habitat since the newly hatched fry migrate directly to the ocean. Thus, pink salmon can be found in almost every small stream where there is at least some low gradient spawning area, usually in the intertidal zones and the channel areas directly upstream. Plateau Creek had very few coho salmon spawners, but had thousands of spawning pink salmon in 1997 and 1998 (personal observations). Chum salmon prefer larger streams with large estuarine areas, but they are well distributed throughout the area (ADFG Anadromous Fish Stream Viewer).

The mountainous terrain also limits the number of lakes in the area, which restricts the number of systems with sockeye salmon. Juvenile sockeye salmon almost always rear in lakes, although they sometimes rear in estuarine areas (Murphy et al. 1989). Because of the lack of lakes, only four known systems have sockeye salmon populations, including the Rude River where there is no lake (ADFG Anadromous Fish Stream Viewer).

One other prominent landtype is the valley floodplain located in the U-shaped valleys formed by glaciers. Almost all of the largest streams are in these valleys, including the Rude River, Simpson Creek, Gravina River, Keta Creek, Silver Lake drainage, Jack Bay drainage, Sheep River, and other systems. Again, several factors reduce coho salmon production in these streams. Glacial streams deposit large quantities of sediment in the lower gradient areas. This deposition causes the channels to fill and shift and also fills the pools which are the preferred juvenile coho salmon habitat. High levels of glacial silt in the streams can also irritate the gills of fish, making these streams less suitable for rearing.

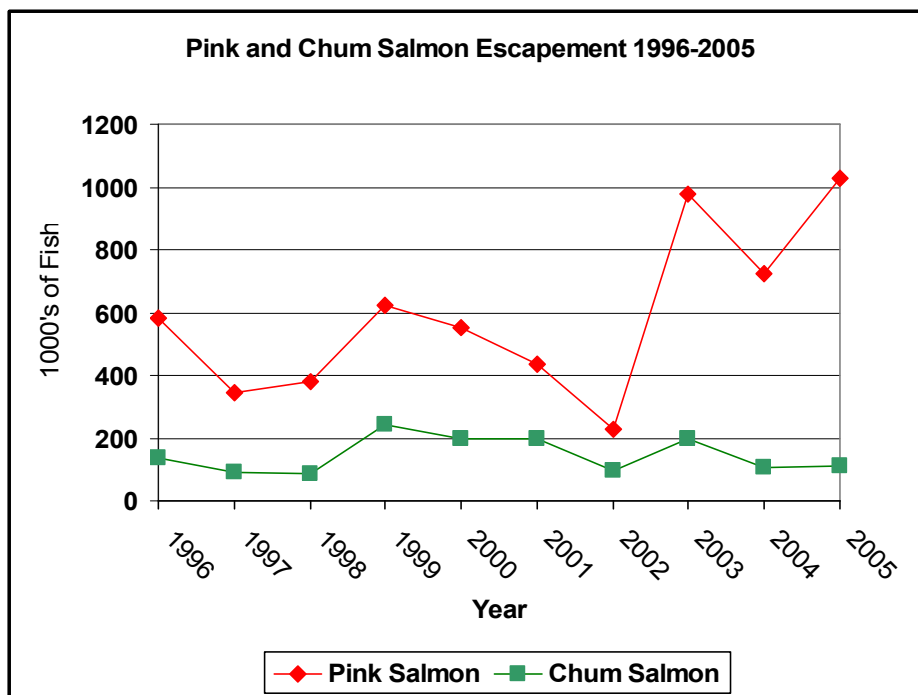
The steep sideslopes of these U-shaped glacial valleys also limit the amount of low gradient side channels and smaller tributaries that juvenile coho salmon could use for rearing. High densities of fry can occur where side slope streams hit the valley floor as in the Rude River system (Andy Morse, USDA Forest Service, personal communication), but the habitat is not as extensive as it might be for a river of that size in a different landform setting. Gravina River also has a coho salmon population, but none of the other major systems in these valleys have documented populations (ADFG Anadromous Fish Stream Viewer).

Pink and chum salmon are the species most often found in the valley floodplain streams. Their only freshwater requirement is a spawning area with sufficient flow to keep the gravels relatively free of glacial silt and keep the eggs watered during low winter flows. Thus, both of these species are present in all of the major valley systems and where the streams empty into the bays in the estuarine areas.

The landform type most conducive to coho salmon habitat is the lowland area on the Knowles Head Peninsula, particularly around Hell's Hole. The floodplain and palustrine channel types are more prevalent in these low gradient areas, providing better rearing and spawning areas. These lowland areas also have extensive estuarine channels and lagoons. Although salt water intrudes into these areas, juvenile coho salmon not only tolerate brackish water, but seem to prefer salinities of 7 to 14 ppt (parts per thousand) (Otto and McInerney 1970). Although no salinity measurements have been taken, it is likely that there are large areas of brackish water or freshwater lenses where the creeks enter the lagoons. These areas could provide critical winter rearing habitat, which is generally in short supply in the streams of the analysis area.

Alluvial fans formed where streams deposit material at the base of steep slopes can provide good spawning area if the stream is large enough to continue flowing when water levels drop during the winter. If the fans lead directly to the ocean, the streams are generally too short to support significant coho salmon populations, but can be important pink and chum salmon streams. If the fans are located along valley floors, the streams can provide moderate amounts of spawning and rearing habitat for coho salmon (USDA Forest Service 1992).

**Fish populations** - Pink and chum salmon escapement counts appear to be relatively stable with somewhat higher numbers in recent years based on aerial index counts conducted by the ADFG (Fig. 2.14). No counts are made in the analysis area for sockeye or coho salmon. These counts are not actual population estimates, but are used to compare the relative annual run strength and determine long-term trends. Many of the smaller creeks cannot be counted from the air, so the overall population numbers are probably greater than the index counts. Still, these counts are useful for roughly determining the magnitude of the populations. The Cordova Ranger District has conducted pink and chum salmon counts at Control Creek in Port Gravina where there is a fish ladder. Pink salmon have been counted sporadically at Olsen Creek (1931-32, 1953-55, 1962-65) for various federal studies (Helle et al. 1964, Thorsteinson et al. 1971). No other data have been collected on a consistent basis.



**Figure 2.14 - Pink and chum salmon escapements in the Eastern commercial fisheries district 1996-2005. Numbers are thousands of fish.**

The pink salmon escapement counts have averaged 476,000 from 1966 to 2005 in the Eastern commercial fishing district, which is composed of the streams in this analysis area (Hollowell et al. 2007). During the last 10 years with available data (1996 - 2005), the count has averaged 587,000. This increase could be due to any of a number of reasons: more favorable ocean or climate conditions, the commercial fleet targeting hatchery fish in other areas, straying of hatchery fish into the area, more consistent aerial counts, or changes in the management strategies of the commercial fisheries. The reports do not include numbers in individual streams, but the areas with the largest populations are Port Gravina (with Olsen and Beartrap creeks), Valdez Arm (with Jack Bay, Indian Creek, and numerous other creeks), and Simpson/Sheep Bay (Sheep and Koppen creeks).

Chum salmon escapement counts have averaged 103,000 from 1965 to 2005 and 147,000 from 1996 to 2005 (Hollowell et al. 2007). Again, changes in ocean conditions, increased harvest of hatchery stocks elsewhere, and other factors may account for the recent escapement increase in the analysis area. ADFG has conducted surveys recently to detect the presence of straying hatchery chum salmon in the area, but the numbers have been low. (This issue is discussed in the section on hatcheries.) Port Gravina has the highest counts of chum salmon, followed by the Valdez Arm streams, and the Simpson/Sheep Bay area.

Coho salmon population data have been limited to a few project-related counts by the Cordova Ranger District and two years of surveys by ADFG in the Nelson Bay area. In 1999, the Forest Service surveyed the Hell's Hole watershed on the Knowles Head Peninsula, which probably has one of the larger populations in the analysis area. The crews counted 419 adult coho salmon in the three forks of the system (unpublished US Forest

Service (USFS) data). Forest Service crews also counted 1, 0, and 10 spawners in 1996-1998, respectively, in connection with an enhancement project at Plateau Creek. ADFG ground crews reported an estimated 101 adult coho salmon in a creek along the north side of the Rude River valley in 2004 (Kampshoff et al. 2005), and an estimated 495 were observed in the Rude River during an aerial survey in 2005 (Kampshoff et al. 2006 *in press*).

The Gravina River and Irish Creek may have moderate adult coho salmon populations judging from the available habitat, but no surveys have been conducted. None of the systems in the analysis area are thought to have more than a few thousand adult fish.

Very little population data are available for sockeye salmon, but an unnamed stream in Port Fidalgo and the Gravina River are thought to have the largest populations. Kampshoff et al. (2005) reported 10 sockeye in an unnamed stream in the Rude River valley in 2004 and 36 in 2005 (Kampshoff et al. 2006). A map in a report by Howse (1975) has a symbol indicating a stock of 500 to 5,000 sockeye salmon at Milton Lake, but it is possible that this population has been extirpated. Dick Groff (retired USFS) worked with Howse and feels that his reports were accurate, suggesting that there must have been some basis for this inclusion. Groff, however, has lived in the Cordova area continuously since that time and fishes the Milton Lake system for cutthroat trout. He cannot recall having seen sockeye salmon in the system (personal communication 2007). Sockeye salmon are not listed as being present in the ADFG anadromous catalog. Gravina River, Beartrap Creek, Irish Creek, and Sheep Creek are listed by Howse (1975) as having small reproducing stocks or very small numbers of strays. No other information is available.

## **Vegetation**

Around 14,000 years ago, the glaciers which covered the area began to recede and plants steadily moved in from the south and from glacial refuges in Alaska. Extrapolating from paleoecological evidence (Heusser 1983, Peteet 1986), coniferous forests became established about 3000 years ago.

Vegetation of the area is described in DeVelice et al. (1999). Characteristic tree species include Sitka spruce (*Picea sitchensis*), mountain hemlock (*Tsuga mertensiana*), and western hemlock (*T. heterophylla*). Undergrowth species common beneath tree canopies include: early blueberry (*Vaccinium ovalifolium*), Alaska blueberry (*V. alaskense*), devil's club (*Echinopanax horridum*), rusty menziesia (*Menziesia ferruginea*), copperbush (*Cladanthamnus pyroliflorus*), skunk cabbage (*Lysichiton americanus*), deer cabbage (*Fauria crista-galli*), Pacific reedgrass (*Calamagrostis nutkaensis*), wood fern (*Dryopteris dilatata*), splendid feathermoss (*Hylocomium splendens*), and gooseneck mosses (*Rhytidiadelphus* spp.). Tall shrublands dominated by Sitka alder (*Alnus crispa* var. *sinuata*) and salmonberry (*Rubus spectabilis*) characterizes avalanche chutes and beach fringe areas. Characteristic species of the low shrublands and herblands include crowberry (*Empetrum nigrum*), bog blueberry (*Vaccinium uliginosum*), deer cabbage (*Fauria crista-galli*), tall cotton grass (*Eriophorum angustifolium*), tufted bulrush (*Trichophorum caespitosum*), fewflower sedge (*Carex pauciflora*), manyflower sedge (*Carex pluriflora*), and sphagnum mosses (*Sphagnum* spp.).

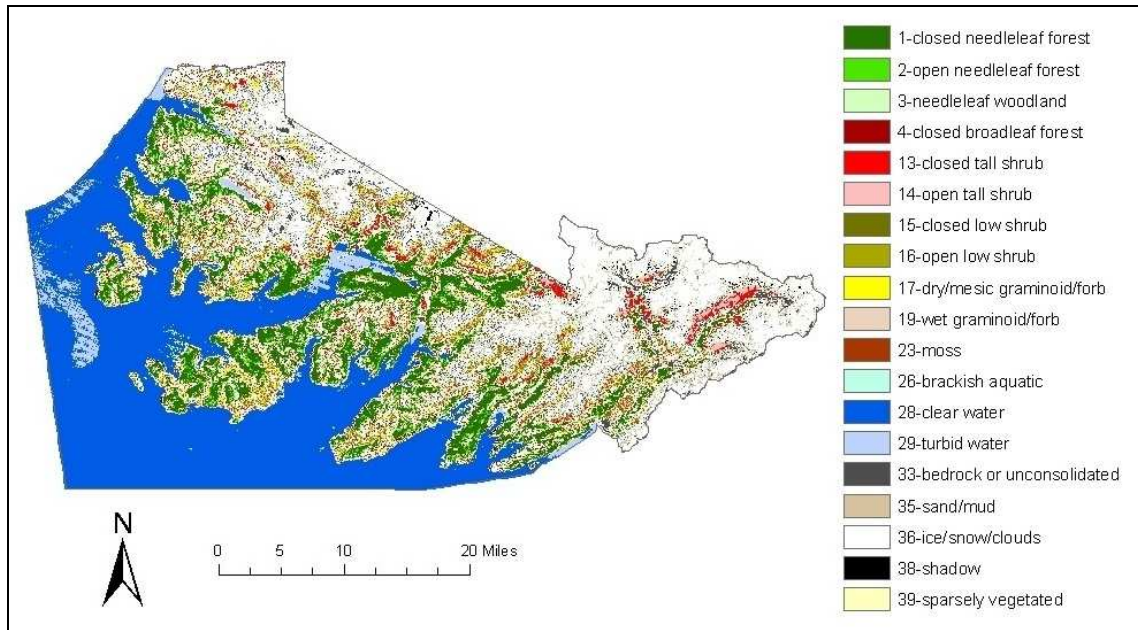
Table 2.4 and Figure 2.15 display the land cover classes of the analysis area and their acreages based on the Markon and Williams (1996) classification. Roughly 30% of the land area is forested, 30% is shrub dominated, 10% is herbaceous, and 30% is non-vegetated (including rock, snow, and ice) or sparsely vegetated.

**Table 2.4 - Acreage of each landcover class for the East Prince William Sound analysis area. Data from the USDA Forest Service (1997) "Landcov" data theme.**

Land Cover Class	Acre	Percent of Land Area	Generalized Class	Percent of Land Area
<b>Mostly land</b>				
Closed Needleleaf Forest	154,221	28.7	Forests	29.6
Open Needleleaf Forest	4,883	0.9		
Needleleaf Woodland	421	0.1		
Closed Broadleaf Forest <sup>2</sup>	44,941	8.4	Shrubland	28.3
Closed Tall Shrub	57,431	10.7		
Open Tall Shrub	10,372	1.9		
Closed Low Shrub	13,558	2.5		
Open Low Shrub	25,786	4.8	Herbaceous	7.2
Dry/Mesic Graminoid/Forb	35,912	6.7		
Wet Graminoid/Forb	2,928	0.5		
Moss	0	0.0	Sparsely Vegetated and Non-Vegetated	34.9
Brackish Aquatic	57	0.0		
Bedrock or Unconsolidated	52,862	9.8		
Sand/Mud	50	0.0		
Ice/Snow/Clouds	115,319	21.4		
Shadow	8,488	1.6		
Sparsely Vegetated	10,967	2.0		
<b>Total land area</b>	<b>=</b>	<b>538,196</b>	<b>100.0</b>	<b>100.0</b>
<b>Mostly marine</b>				
Clear Water	281,500	---		---
Turbid Water	17,636	---		---

<sup>2</sup> Since broadleaf trees are rare within the analysis area, "closed broadleaf forest" is likely a misclassification and is actually "closed tall shrub".





**Figure 2.15 - Land cover classes for the East Prince William Sound analysis area. Data clipped from the USDA Forest Service (1997) “Landcov” data theme.**

### Wildlife

Elevations in the analysis area range from sea level along the coast to 5,800 feet near Mt. Denison. Wildlife habitat is quite diverse (Fig 2.15). Wildlife populations reflect the pristine vegetation in the area and its remoteness. All native fauna is intact.

The following is a discussion of species of concern to the US Fish and Wildlife Service (USFWS), ADFG, USFS, or have other notable issues surrounding them (i.e. hunting, viewing, etc.). Sensitive Species are those plant and animal species identified by the USFS Regional Forester for which population viability is a concern on National Forest System lands within the region. Federally listed Threatened and Endangered Species are those plant and animal species formally listed by the USFWS under authority of the Endangered Species Act of 1973, as amended. ADFG lists Species of Special Concern as any species or subspecies of fish or wildlife or population of mammal or bird native to Alaska that has entered a long-term decline in abundance or is vulnerable to a significant decline due to low numbers, restricted distribution, dependence on limited habitat resources, or sensitivity to environmental disturbance. The Final Environmental Impact Statement (FEIS) for the Chugach Forest Plan outlines important habitat components and conservation options for selected species of concern in Table 3-39 on page 3-230 and lists management indicator species and species of interest in Table 3-50 on page 3-231 (USDA Forest Service 2002a).

**Birds** - Over 219 bird species have been documented within the North Gulf Coast-Prince William Sound Region of Alaska (Isleib and Kessel 1973). The conservation of birds is complex due to the migratory nature of many species. Additionally, bird species fall under various management authorities depending on their population trends and game status. Table 2.5 lists the bird species likely present in the analysis area of concern for the USFWS,

USFS, ADFG, or the National Audubon Society (NAS). Following the table is a description of species or groups of birds meriting special attention in the analysis area.

<b>Table 2.5 - Bird species likely occurring in the analysis area that the USFWS, USFS, ADFG or NAS have special conservation concerns about.</b>				
<b>Common Name</b>	<b>Latin Name</b>	<b>Occurrence</b>	<b>Abundance</b>	<b>Conservation Concern</b>
<b>Loons and Cormorants</b>				
Red-throated loon	<i>Gavia stellata</i>	Breeds, Winters	Common	A <sup>3</sup>
Yellow-billed loon	<i>Gavia adamsii</i>	Winter	Common	A
<b>Waterfowl</b>				
Canada goose	<i>Branta canadensis</i>	Migrant, Breeds	Common	S, M <sup>4</sup>
Long-tailed duck	<i>Clangula hyemalis</i>	Winters	Uncommon	A
Trumpeter swan	<i>Cygnus buccinator</i>	Migrant, breeds, winters	Common	A, S <sup>5</sup>
Black scoter	<i>Melanitta nigra</i>	Winters	Uncommon	A
Steller's Eider	<i>Polyicta stelleri</i>	Winters	Rare	T <sup>6</sup> , A
<b>Raptors</b>				
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Resident	Abundant	I <sup>7</sup>
Peregrine Falcon	<i>Falco peregrinus</i>	Breeds, Migrant	Uncommon	A, C <sup>8</sup> , S
Northern goshawk	<i>Accipiter gentilis</i>	Breeds, Winters	Common	I
Osprey	<i>Pandion haliaetus</i>	Migrant	Uncommon	S
<b>Shorebirds</b>				
Surfbird	<i>Aphriza virgata</i>	Migrant	Common	A
Dunlin	<i>Calidris alpina</i>	Migrant, Winters	Common	A
Black oystercatcher	<i>Haematopus bachmani</i>	Breeds, Winters	Common	A,M
Wandering tattler	<i>Heteroscelus incanus</i>	Migrant, Breeds	Uncommon	A
Hudsonian godwit	<i>Limosa haemastica</i>	Migrant	Uncommon	A
Solitary sandpiper	<i>Tringa solitaria</i>	Migrant	Common	A
<b>Terns and Alcids</b>				
Kittlitz's murrelet	<i>Sterna aleutica</i>	Breeds	Uncommon	A
Marbled murrelet	<i>Brachyramphus marmoratus</i>	Winter, Breeds	Common	A
Aleutian tern	<i>Sterna aleutica</i>	Breeds	Uncommon	A
<b>Flycatchers and Songbirds</b>				
Olive-sided flycatcher	<i>Contopus cooperi</i>	Migrant, Breeds	Rare	A, C
Rufous hummingbird	<i>Selasphorus rufus</i>	Migrant, Breeds	Common	A
Gray-cheeked thrush	<i>Catharus minimus</i>	Breeds	Uncommon	C
Townsend's warbler	<i>Dendroica townsendi</i>	Breeds	Common	C, I
Rusty blackbird	<i>Euphagus carolinus</i>	Winter, Breeds	Uncommon	A

<sup>3</sup> A= Audubon Watch List

<sup>4</sup> M = USFS Chugach NF Management Indicator Species

<sup>5</sup> S = USFS Sensitive Species

<sup>6</sup> T = USFWS Threatened Species

<sup>7</sup> I = USFS Species of Interest

<sup>8</sup> C = ADFG Species of Concern

### *Dusky Canada goose*

The dusky Canada goose (*Branta canadensis occidentalis*) is a USFS Alaska Region sensitive species. Its breeding range is restricted to the Copper River Delta and wetlands east to Bering Glacier, Prince William Sound, and Middleton Island (Campbell 1990). It winters primarily in the Willamette Valley in Oregon and along the Columbia River in Washington (Comely et al. 1988, Bartonek et al. 1971). Canada geese in the Sound are genetically distinct from dusky Canada geese, however because of their similarities in morphology, migration, and wintering areas, they are managed as dusky Canada geese and their harvest is strictly regulated near their wintering grounds in Oregon. Canada geese nest on small islands and shorelines of the Sound, but little is known of nesting densities or productivity.

### *Steller's Eider*

The Steller's eider is a Threatened species listed by the USFWS and on the Audubon WatchList (National Audubon Society 2002). It is a rare winter visitor along the North Gulf Coast and in Prince William Sound (Isleib and Kessel 1973), normally wintering in coastal waters well to the west of the Sound. It breeds along the western and northern coasts of Alaska. Although it has not been recorded within the analysis area, Steller's eider has been seen in adjacent waters in Prince William Sound. Threats to this species in North America are not well known. This species occupies marine habitats within Prince William Sound; actions on Chugach National Forest System lands would have little effect on this species.

### *Kittlitz's Murrelet*

The USFWS published a revised list of Candidate Species in the Federal Register on May 4, 2004. A Candidate Species is a species for which the USFWS has sufficient information to propose listing as endangered or threatened, but for which preparation and publication of a proposal is precluded by higher-priority listing actions. This list includes Kittlitz's murrelet, a small diving seabird that inhabits Alaskan coastal waters discontinuously from Point Lay south to northern portions of Southeast Alaska and appears to be in significant population decline. The Forest Service Alaska Region plans a thorough review of the Regional Sensitive Species and anticipates adding the Kittlitz's murrelet to the list.

The Kittlitz's murrelet is an uncommon and secretive breeder; only about 2 dozen nest records exist (Day et al. 1999). All of the North American and most of the world population of Kittlitz's murrelets breed, molt, and winter in Alaska. During the breeding season, the distribution is highly clumped within its geographic range (Isleib and Kessel 1973), with birds congregating near tidewater glaciers, and to a lesser extent, offshore of remnant high-elevation glaciers and deglaciated coastal mountains (Day et al. 1999, Day and Nigro 1999). The literature indicates that this species nests in unvegetated scree fields, coastal cliffs, barren ground, rock ledges, and talus above timberline in coastal mountains, generally in the vicinity of glaciers, cirques near glaciers, or recently glaciated areas, primarily from the Alaska Peninsula to Glacier Bay (Day et al. 1999, Day et al. 1983, Day 1995, Piatt et al. 1999). During the non-breeding season, the marine distribution of Kittlitz's murrelets is farther offshore. In winter, few Kittlitz's murrelets occur in the protected waters of Prince William Sound, Kenai Fjords, Kachemak Bay, and Sitka Sound (Kendall and Agler 1998, Day et al. 1999). Tidewater glaciers are not present in the analysis area and Kittlitz

populations are thought to be low, however few data exist for Kittlitz's murrelet use of the analysis area, and they may be present in small numbers.

#### *Marbled Murrelet*

The marbled murrelet is a USFS Alaska Region species of special interest and on the Audubon WatchList (National Audubon Society 2000). The marbled murrelet is a small seabird that feeds on small fish and invertebrates and nests in trees. Throughout much of its range in the Pacific Northwest, British Columbia, and Alaska, the marbled murrelet nests in large, mature, coniferous trees in structurally complex, coastal old growth stands.

Marbled murrelets are numerous and widespread throughout the coastal waters of Alaska with estimates of 100,000 occurring in the Sound (Kuletz 1997). Marbled murrelets nest, feed, and winter in the analysis area. Population trends within the Chugach National Forest have been downward, with a 67% decline since surveys were initiated in 1972; however, populations have been stable since 1990 (Kuletz 1997). Possible causes of murrelet declines include oil spills, mortality from gill netting, cyclical changes in marine productivity, and the harvesting of old-growth forest. Suitable nesting habitat for marbled murrelets exists in forest stands throughout the analysis area and around the perimeter of the Sound, and most has been little modified by humans. Undoubtedly, logging in the Knowles Head, Nelson Bay, and Fish Cove areas has reduced the amount of nesting habitat until those young stands regain structure suitable for nesting habitat. However, logging is not widespread in the analysis area and is not expected to be in the future.

#### *Northern Goshawk*

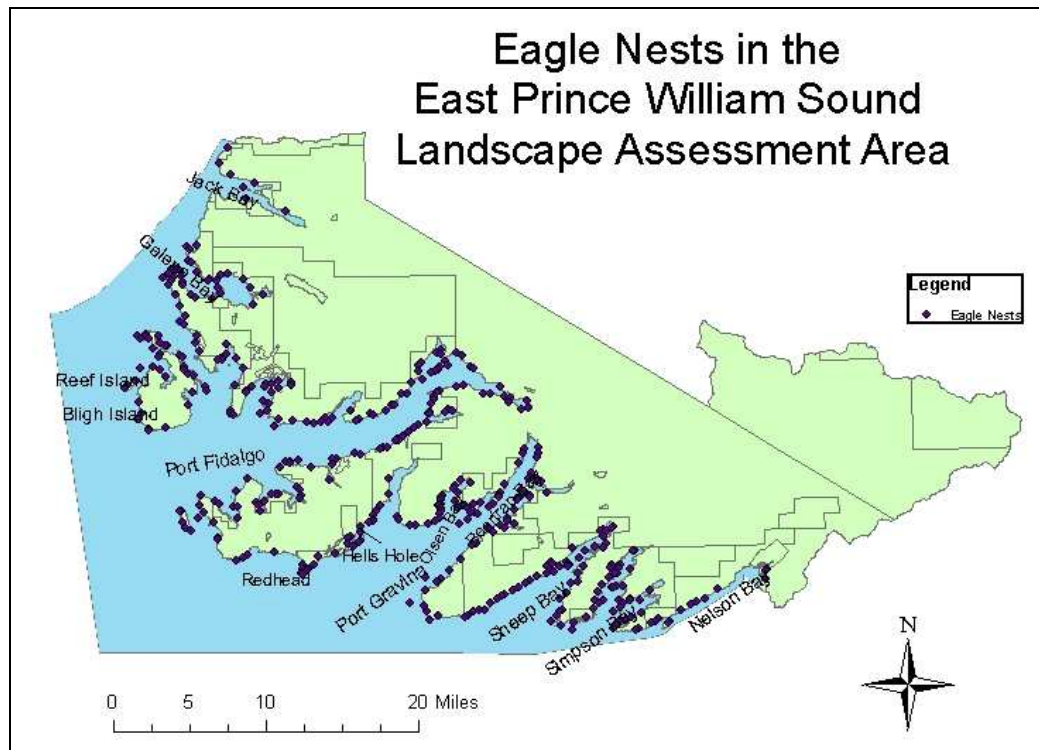
The northern goshawk, the largest North American accipiter, is a USFS Alaska Region and Chugach NF species of special interest. It is a forest habitat generalist, breeding in coniferous, deciduous, and mixed forests across its holarctic range (Reynolds et al. 1992). The species is considered a non-migratory resident in the Prince William Sound area and is a fairly common resident of the North Gulf Coast and Prince William Sound (Isleib and Kessel 1973). No goshawk nests are known in the analysis area; however, they likely occur in the appropriate forest habitats.

While goshawks occur in a variety of forest successional stages, it is believed that nesting birds are most commonly associated with mature forests (Crocker-Bedford 1993, Titus et al. 1994, Titus 1996). Preferred habitat during the breeding season is mature and old growth forest with structural characteristics that allow goshawks to maneuver in and below the canopy while foraging and large trees for nesting (Reynolds et al. 1992). In Alaska, goshawks are most often associated with old growth forests (McGowan 1975, Crocker-Bedford 1993, Titus 1996).

#### *Bald eagle*

The bald eagle is an abundant and conspicuous resident of the North Gulf Coast and Prince William Sound region (Isleib and Kessel 1973). Bald eagles are year-round residents using old growth timber (spruce hemlock, cottonwood) for nest sites, and feeding in streams, lakes, and marine waters. Salmon spawning in streams can concentrate large numbers of eagles. The bald eagle is a species of special interest on the Chugach National Forest. The

USFWS and USFS maintain an interagency agreement for bald eagle habitat management in the Alaska Region, which includes standards and guidelines for regulating human disturbance within identified bald eagle use areas. The minimum retention zone is 330 feet around known eagle nest locations. The active bald eagle nesting season is generally from March 1 to August 31. Known eagle nest locations are displayed in Figure 2.16.



**Figure 2.16 - Bald Eagle nest locations in the East Prince William Sound analysis area.**

### *Osprey*

The osprey is a USFS Alaska Region sensitive species. It is an uncommon migrant and rare local breeder in the North Gulf Coast-Prince William Sound region (Isleib and Kessel 1973). It most likely has always been uncommon in coastal southcentral Alaska and more common in interior Alaska. No documented nests have been found in the analysis area and sightings are generally restricted to migration.

### *Peregrine falcon*

The Peale's subspecies of peregrine falcon (*F. p. pealei*) is a USFS Alaska Region sensitive species. Other subspecies of the peregrine falcon, which may use the analysis area in migration, appear on the Audubon WatchList or are considered species of concern by ADFG (National Audubon Society 2002). The peregrine falcon is a rare resident of the North Gulf Coast and Prince William Sound region. Most birds in the region appear to be *F. p. pealei*, but some migrants and one winter observation appeared to be the rare *F. p. anatum* (Isleib and Kessel 1973).

During spring migration, peregrines appear most frequently between April 15 and May 5. Twelve to 20 pairs breed along the North Gulf Coast (Isleib and Kessel 1973). Eyries are on

or in view of the coast and are generally associated with nesting seabird colonies or waterfowl breeding areas. Peregrine falcons probably nest in the analysis area. Documented sightings have occurred on nearby Hinchinbrook, Montague, and Wooded Islands.

#### *Rufous Hummingbird*

The rufous hummingbird is a National Audubon WatchList species because of declining populations (National Audubon Society 2002). Causes for these declines are not well known. They are common migrants and breeders in the North Gulf Coast and Prince William Sound region (Isleib and Kessel 1973).

#### *Olive-sided flycatcher*

The olive-sided flycatcher is considered a species of special concern by the ADFG and is on the Audubon WatchList (National Audubon Society 2002). They are considered rare within Prince William Sound (Isleib and Kessel 1973); however, they have been seen near Cordova during migration. Olive-sided flycatchers breed in interior Alaska.

#### *Townsend's warbler*

The Townsend's warbler is considered a species of special concern by the ADFG and is a species of special interest on the Chugach National Forest. It is a common, migratory breeder throughout southcentral Alaska. They usually arrive from mid-May through early June and leave Alaska in August (Isleib and Kessel 1973). Townsend's warblers likely inhabit spruce-hemlock/alder forest, spruce-hemlock forest, and alder habitats within the analysis area (Lance et al. 1996).

#### *Gray-cheeked Thrush*

The Gray-cheeked thrush is considered a species of special concern by ADFG. According to Isleib and Kessel (1973), this thrush is a rare migrant and rare local breeder in the Prince William Sound-North Gulf Coast region.

#### *Shorebirds*

Millions of shorebirds use Prince William Sound during migration and many species nest in the area. Black oystercatchers are considered a Management Indicator Species on the Chugach National Forest and are on the Audubon WatchList. Many other species of shorebirds also appear on the Audubon WatchList. On page 3-32, the Forest Plan recommends locating human activities to avoid disturbance of known shorebird intertidal concentration or nesting areas as follows: provide a minimum distance of 330 feet from human activities on the ground from shorebird intertidal concentration or nesting areas (including black oystercatchers). Forest vegetation within these zones is considered to be unsuitable for timber production.

Black oystercatchers nest within the area at medium densities. The locations of many nests on low gradient gravel beaches make them particularly vulnerable to disturbance by recreationists. Other nesting shorebirds in the analysis area include semi-palmated plover, greater yellowlegs, common snipe, spotted sandpiper, wandering tattler, and possibly red-necked phalaropes. The beaches of Prince William Sound are also used during a more

protracted fall migration for various species. Winter visitants include rock sandpiper, dunlin, and small numbers of surfbird and sanderling.

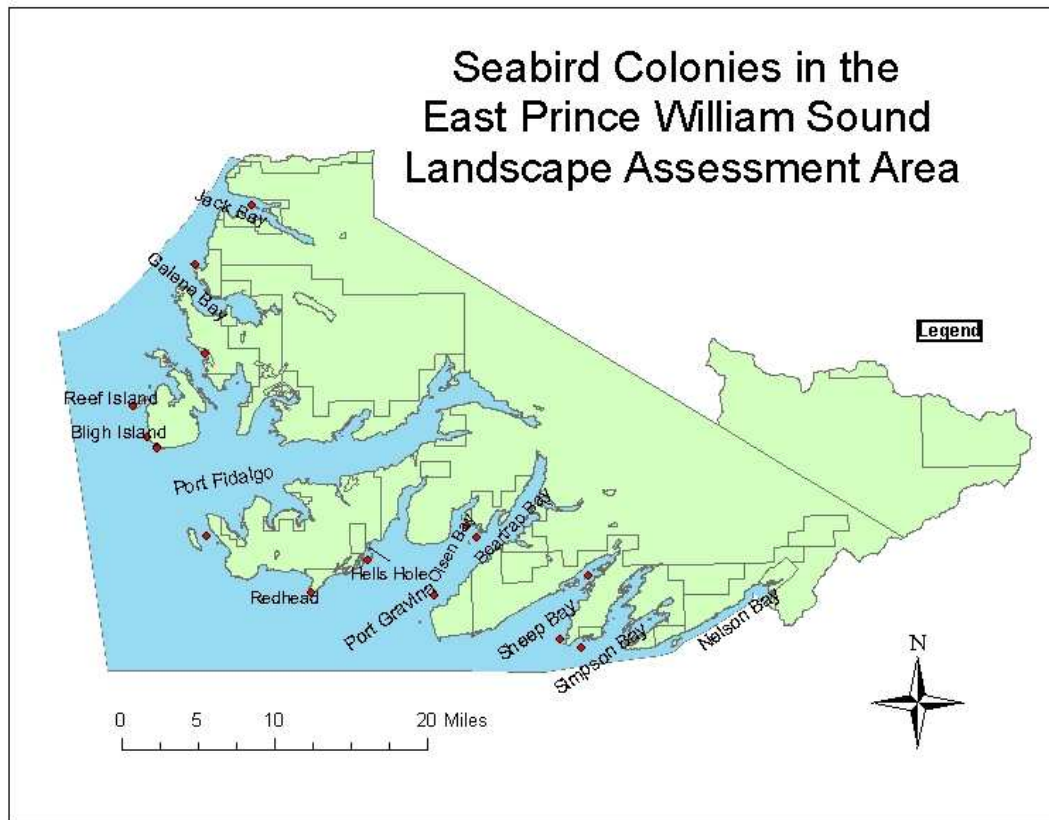
Human activity in the Sound is increasing at a rapid rate, largely due to better access from Anchorage via the Whittier tunnel. Much of this activity takes place in shoreline habitat where black oystercatchers nest. The Cordova Ranger District began shoreline surveys for black oystercatchers in the Sound in 1999. During these surveys, locations of all water birds, with an emphasis on black oystercatchers, are recorded. In subsequent years district personnel have surveyed the mainland shoreline in the entire eastern Prince William Sound analysis area.

### *Seabirds*

Many seabird colonies exist along the shorelines of the analysis area including nesting pigeon guillemots (*Cepphus columba*), arctic terns (*Sterna paradisaea*), Aleutian terns, black-legged kittiwakes (*Rissa tridactyla*), glaucous-winged gulls (*Larus glaucescens*), and mew gulls (*Larus canus*). These species generally nest in areas that are safe from mammalian predators such as small islands and cliffs. Kittiwakes generally prefer cliffs. Mew and glaucous-winged gulls as well as Aleutian and arctic terns will nest on the ground in habitats ranging from dunes and marsh to rock outcrop islands. Recent counts of seabird colonies are provided in Table 2.6 and shown in Figure 2.17.

<b>Table 2.6 - Seabird colony and Black Oystercatcher counts in the East Prince William Sound Analysis Area (USFWS 2000).</b>							
Location	Black Oyster-catcher	Mew Gull	Glaucous-winged Gull	Black-legged Kittiwake	Arctic Tern	Aleutian Tern	Pigeon Guillemot
Simpson Bay					18		
Hanks Island	2	4					
Sheep Point				14	2		
Gravina Rock					16		
Parshas Bay	2				2		
Olsen Bay-mouth	2				54		
Hells Hole	8				20	40	
Redhead							2
Gull Island	2		70	14	10		
Bligh Island							53
Reef Island							4
Ellamar			5	32	90		
Galena Bay	2				40		
Jack Bay		20					
N. Valdez Arm-Hatch							15





**Figure 2.17 - Seabird colony locations in the East Prince William Sound analysis area.**

**Mammals** – No comprehensive mammal list for the analysis area exists. Much of the habitat and the associated mammal species are in near pristine condition. Two mammal species in or near the analysis area are listed as endangered by the USFWS: the humpback whale (*Megaptera novaeangliae*) occurs strictly in marine waters, while the Steller sea lion (*Eumetopias jubata*) occurs in marine waters but has haul-out sites on National Forest System lands. Following are species meriting special attention in the analysis area.

#### *Brown bear*

Brown bears (*Ursus arctos*) are present in the analysis area and are a Chugach Forest Management Indicator Species. However no data exists on brown bear densities. In the spring, avalanche paths and tidal grass flats are important sources of herbaceous vegetation. Bears use berry patches during summer, and salmon streams are important to bears during summer and fall. Bears concentrate to fish for salmon in Olsen Creek and Bear Trap Bay and it is likely that other salmon streams used by bears are present in the analysis area.

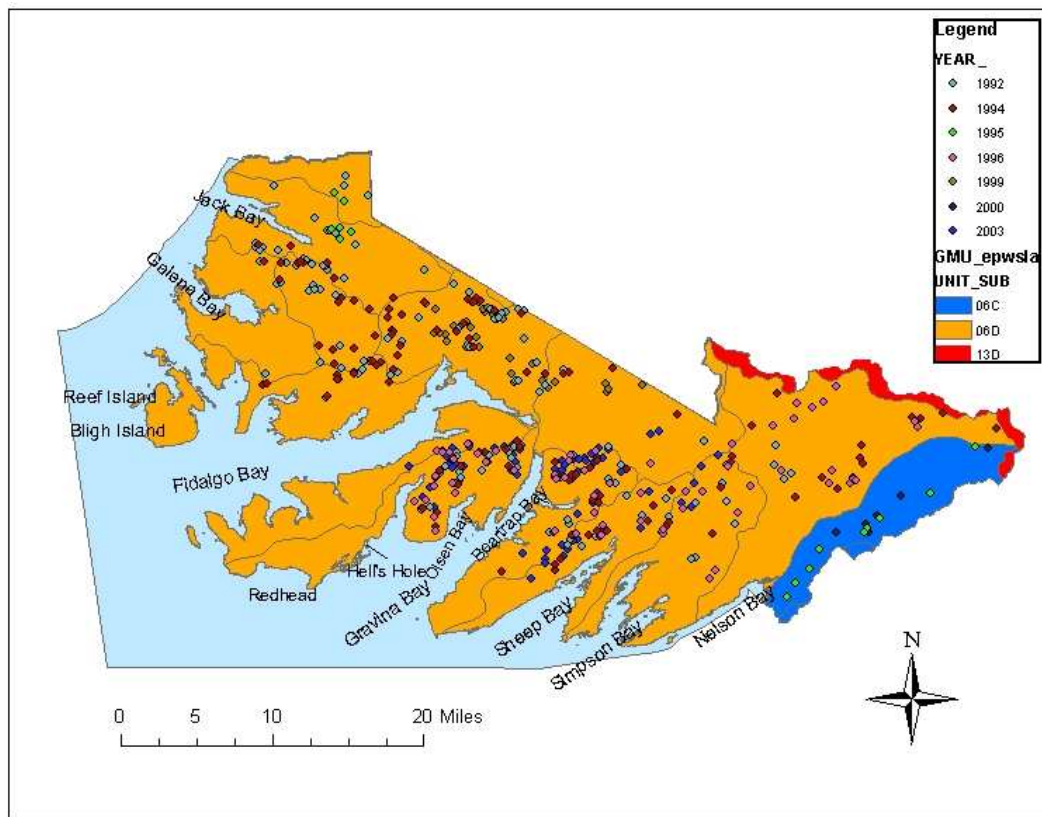
On page 3-30, the Forest Plan recommends a 750-foot brown bear management zone around bear feeding areas, between areas used by brown bears and areas used by humans. New road construction and vegetation management not intended to maintain or improve brown bear habitat in this management zone is not allowed.

### *Mountain goat*

The mountain goat (*Oreamnos americanus*) is a Chugach National Forest Management Indicator Species. The Cordova Ranger District contains vast areas of mountain goat habitat (Fig. 2.18). Mountain goats are important to the local communities around the Chugach for sport harvest, subsistence harvest and wildlife viewing. Some of the areas that goats inhabit are important to both residents of Alaska and visitors for outdoor recreation (i.e. heliskiing).

Winter is a period of severe nutritional deprivation and food scarcity for mountain goats (Fox et al. 1989). Quantity and quality of winter habitat are the most limiting factors for mountain goats in Southcentral Alaska (Suring et al. 1988). Mountain goats are sensitive to disturbance (Chadwick 1973) and when disturbed on a regular basis, they become highly stressed and can abandon ranges.

The National Forest Management Act requires the US Forest Service to manage fish and wildlife habitat to maintain viable populations of existing native and desired non-native vertebrate species in the planning area (USDA Forest Service 2002a). The Chugach Forest Plan (p 4-61) states that recreational activities may be seasonally restricted to meet wildlife habitat objectives or to reduce wildlife-human interactions in important habitat areas or movement corridors. However, these important habitat areas and movement corridors have not yet been identified for wintering goats over much of the Cordova Ranger District.



**Figure 2.18 - Mountain goat sightings from fall surveys in the analysis area.**

### *Sitka black-tailed deer*

Sitka black-tailed deer is a Chugach National Forest species of special management interest and is important to both sport and subsistence hunters. They are indigenous to the coastal regions of Southeast Alaska and northwest British Columbia. They were introduced to Hinchinbrook and Hawkins Islands from Sitka in 1916 with later supplemental stockings prior to 1925 (Burris and McKnight 1973). At least 24 deer were released on Hawkins and Hinchinbrook islands. Sitka black-tailed deer spread throughout Prince William Sound and the mainland and peaked in population numbers by 1945 (Greise and Becker 1988). Deer are at the northern limit of their range in Prince William Sound and populations on the islands have reached higher densities than on the nearby mainland. Snow intercept by tree canopies in mature forests provide accessible forage and shelter during winter (Shishido 1986, Reynolds 1979).

Old-growth forests have the highest value during winter because they intercept snow and provide access to understory forage plants. Snow depths greater than 2 feet push the deer to lower elevations; in some winters, down to the beach fringe where snow accumulation is reduced or absent. Key deer winter range consists of uneven-aged climax conifer stands with enough gaps in the canopy to allow the understory shrub growth necessary for forage production (Shishido 1986). Table 5.2 lists acres to treat by year, and Figure 5.1 illustrates where and when treatment will take place. The Knowles Head Restoration Plan has detailed information about treatments including estimated costs. Planned activities have been entered into the National Forest Activity and Tracking System (FACTS) database.

### *River Otter*

River otter (*Lutra canadensis*) was a species of special concern after the 1989 *Exxon Valdez* Oil Spill but is now considered recovered. They den on shorelines and use the nearshore environments for food. River otter appear to select areas of old growth forest and moderate slopes for latrine sites (Bowyer et al 1995). River otter densities in Prince William Sound are approximately 0.28 to 0.80 animals per 0.62 mile (1 km) of shoreline (Testa et al 1994). River otter trapping season runs from about November 10 to March 31, with no bag limit. Harvest pressure can be high in some years. Harvest ranged from 36 individuals in 1998-99 to 176 in 2002-03. Most (61%) of the 2002-2003 harvest was by two experienced trappers working in eastern Prince William Sound. Eighty-three percent of all otters harvested were taken in Subunit 6D (ADFG 2004).

### *Sea Otter*

The sea otter (*Enhydra lutris*) is a conspicuous resident of the Sound, is popular with visitors to the area, and is harvested by natives under the Marine Mammal Act of 1972. By the late 1800s sea otters had been eliminated from most of their historical range in Alaska due to excessive harvesting by fur traders. Surveys in the 1970s and 80s, however, indicated expanding populations in Alaska including the Sound (EVOS Trustee Council 2002). The area around Green Island served as refugia for sea otters during the period of heavy harvest. This remnant population of otters is thought to have been the source of animals repopulating Prince William Sound.

Approximately 1,000 sea otter carcasses were recovered following the *Exxon Valdez* Oil Spill in 1989 and additional animals likely died that were not recovered (EVOS Trustee Council 2002). Sea otters are considered as recovering in all but the portions of the Sound that received the greatest amounts of oil.

#### *Steller sea lion*

The Steller sea lion, (*Eumetopias jubatus*), is listed as Endangered by the USFWS and is a species of special concern for ADFG. Although the eastern population has remained stable at an estimated 39,000 for the last few years, the western population of Steller sea lions has been declining rapidly, from an estimated total of 227,000 in 1960 to 45-46,000 in 2000 (Sease and Gudmundson 2002). In 1997 the U.S. population of the Steller sea lion west of 144°W (Cape Suckling, Alaska, which includes the Prince William Sound population) was reclassified as Endangered under the Endangered Species Act, the remainder of the population remaining classified as Threatened, a status it has held since 1990.

#### *Beaver*

Beavers (*Castor canadensis*) are a common mammal in the analysis area although beaver density is lower in the analysis area than in the adjacent areas of the Copper and Bering River deltas, most likely due to habitat quality (ADFG 2004). Very little is known about the distribution of beavers in the analysis area. Heller (1910) reported beavers in the Rude River drainage. In 1976 Reynolds documented beaver occurrence in Simpson Bay, Rude River and Gravina River (ADFG 2004). Beavers also occur in the Sheep River drainage (ADFG 2004). The beaver trapping season during 2000–01 was December 1 to April 30 with no bag limit. Beginning in 2001–02 the season was November 10 to April 30 with no bag limit. Harvest ranged from a low of 75 during 2001–02, when poor trapping conditions occurred, to a high of 139 during 2000–01 (ADFG 2004). As in past years, 90–100% of the 2000-01 harvest came from Unit 6C which is not in the analysis area.

#### *Grey Wolf*

Wolves (*Canis lupus*) inhabit the interior of Alaska and the Copper River Delta and are rare visitors to a majority of the analysis area. A pack has been reported in the Rude River drainage and may move between the Scott River and the analysis area (Dave Crowley personal communication). The only activity in the analysis area that may influence wolves is recreation in the Rude River drainage. Recreation has the potential to affect gray wolf movements and habitat use during periods of winter foraging and early spring denning. Studies of snowmobile use and wolf movement have shown that wolves tended to avoid areas of snowmobile activities in restricted use areas (USDI National Park Service 1996). Very little winter recreation occurs in these areas and most likely has minimal effects on wolf populations.

**Amphibians** - Only 2 amphibians are found in southcentral Alaska. The wood frog (*Rana sylvatica*) and the western toad (*Bufo boreas*) are uncommon residents of the area. Wood frogs inhabit diverse vegetation from grasslands to forest, muskeg, and tundra and are documented on the west Copper River Delta. Western toads are generally found in open, non-forested areas near fresh water. In Prince William Sound, they have been documented on Montague and Hawkins islands and on the mainland as far west as the Columbia Glacier and as far north as the Tasnuna River (MacDonald 2003). Declines in amphibian

populations have been documented worldwide; no data exists on the status of amphibians on the Chugach National Forest.

## ***Human Dimension***

### **Human occupation**

The Eastern Prince William Sound analysis area was occupied prehistorically by the people of Prince William Sound, the Sugpiaq. Sugpiaq means “real people” and is the term for the Alutiiq people, in the Alutiiq language. While Sugtestun means the Alutiiq language, and is translated “to speak like a person”. The term Alutiiq is the Sugtestun pronunciation of the Russian introduced name Aleut and is commonly used as a self-designation by the people of the Chugach region. The term Chugach is likely derived from the Alutiiq place name for Cook Inlet (Cúngáciq) and refers to the Alutiiq people of Cook Inlet, the Kenai Peninsula and Prince William Sound, and can also refer to the dialect of Alutiiq or Sugtestun (Crowell et al. 2001).

The entire Alutiiq region includes the islands and coastal country of southern Alaska, from the Alaska Peninsula to Kodiak Island, the Kenai Peninsula, Cook Inlet, and Prince William Sound (Crowell et al. 2001). The earliest inhabitants of the Alutiiq Region have been identified in the archaeological record as far back as 10,000 years ago (Crowell et al. 2001). However, the occupation of the Eastern Prince William Sound area has been documented archaeologically to at least 4,000 years ago. The prehistoric Sugpiaq were a maritime-oriented people whose activities focused on the abundance of resources from the sea.

There are eight identified sub-groups of the Chugach people (Johnson 1984). These include:

- The Palugvirmiut of Hawkins, Mummy, and northeastern Hinchinbrook Islands;
- The Nutyirmiut of western Hinchinbrook, based at Nuchek;
- The Alukarmiut of Sheep Bay;
- The Atyarmiut of Gravina Bay;
- The Tatitlarmiut of northeastern Prince William Sound, based at Kunin and Palutag (Ellamar);
- The Kangirtlurmiut (Kiniklik) of northwestern Prince William Sound from Columbia Glacier to Port Wells;
- The Tyanirmiut of Chenega Island, based at Kalakat and Ingimatya; and
- The Shuqlurmiut of Montague and Knight Islands.

Cultural sites have been identified and documented on National Forest System lands within the analysis area. Many of these cultural sites have been selected by the Regional Native Corporation, Chugach Alaska Corporation (CAC) under Section 14(h)(1) of the Alaska Native Claims Settlement Act (ANSCA). These sites are under review for conveyance.

Field surveys to locate all potentially National Register eligible sites have been conducted in response to federal undertakings in order to satisfy the requirements for Section 106 of the National Historic Preservation Act of 1966. However, a large majority of the study area has not been surveyed and inventoried for archaeological resources.

Previously documented prehistoric and historic human use patterns of the area allow for the development of a predictive model of sensitivity zones for cultural resources. Since evidence indicates prehistoric use of the areas in Prince William Sound was generally limited to the littoral zones of less than 150 feet elevation above high tide level and historic use followed similar patterns, this strip of land is considered to have the highest probability for cultural resources. Prehistoric uses which differ from this general model include specific hunting, gathering, and burial practices. Recent archaeological and geological documentation in 2003 of the existence of elevated Holocene beach ridges on Hawkins and Hinchinbrook Islands suggests that the predictive model should include land up to 200 feet above identified beach ridges in the high probability zone.

The Eastern Prince William Sound analysis area includes cultural features of historic significance related to western culture. These cultural features include evidence of mining, timber harvesting, fox farming, commercial fishing, hunting and trapping.

Historical mining activity frequently occurred outside of high probability zones of the predictive model. Mining activities typically occurred throughout the area and were not restricted to areas of natural resource abundance necessary for survival. Areas of high probability include identified mineral deposits, recorded portages or corridors of human movement, and drainage systems identified as having or capable of having anadromous fish runs. The zone of low probability for cultural resources includes areas of permanent ice and snow, swamps, bogs, active stream channels, and alpine rock fields. Areas of 1000 feet elevation and higher are also in the zone of low probability, unless identified in one of the high probability zones, such as a portage or corridor. (USDA Forest Service 2002d)

### **Heritage resources**

The analysis area includes prehistoric and historic remains and a variety of historic properties and property types that are either on or eligible for the National Register of Historic Places (NRHP). Lands owned or managed by private entities, the State of Alaska, Chugach Alaska Corporation, Tatitlek Corporation, and Eyak Corporation are present. During project analysis, archaeological surveys have been conducted on National Forest System lands, as required by Section 106, Part 800 of the National Historic Preservation Act of 1966 (NHPA). However, the entire analysis area has not been inventoried.

Most identified cultural resources within the analysis area have not received formal evaluations for the National Register of Historic Places. However, if a site is determined eligible but not formally nominated to the National Register, the same level of resource protection is granted. Many areas that were surveyed in the past and not formally reported on are subject to further field review and documentation to be considered surveyed to current standards as outlined in Region 10's Programmatic Agreement between the USDA Forest Service, The Advisory Council on Historic Preservation and the State Historic Preservation Office. Although individual heritage resources are assigned Alaska Heritage Resource Survey (AHRS) numbers within the analysis area, a portion of these will need field verification and archaeological survey to qualify to the current standards.

Prehistoric archaeological sites in Prince William Sound date from within the past 4000 years and encompass three cultural phases. The Uqciuvit phase is identified with dates ranging from 4000-2500 B.P., the Palugvik phase with dates ranging from 2500-900 B.P., and the Chugach phase with dates ranging from 900-200 B.P. (Yarborough 2000). In prehistoric times, the Aleut people came into Prince William Sound from the Aleutians Islands and Alaska Peninsula area, where they were the first Alaskans to contact the Russian explorers (Johnson 1984).

The proto-historic period was between A.D. 1741, when Vitus Bering made landfall on Kayak Island, and the beginning of the historic period in A.D. 1778, when Captain James Cook made direct contact with Native inhabitants of Prince William Sound. The period from 1778 through 1867 is characterized as the Russian Period.

The Sugpiaq of the Prince William Sound region controlled the territory as far east as Controller Bay until the early nineteenth century. At that time, Eyak, whose original homeland stretched from an area east of Yakutat to Cape Suckling and possibly Controller Bay, pushed the Sugpiaq out of Controller Bay, with the effect that “mostly pure Eyak people” subsequently occupied the Copper River Delta and the very eastern margins of Prince William Sound (de Laguna 1990:189). Eyak Natives in 1933 described Eyak territory as having at one time extended from Cordova Bay, inside Prince William Sound, east to Martin River, including the Copper River north as far as Miles and Childs Glaciers. The Russians enforced peace between the Eyak and the Sugpiaq, after which the Eyak expanded their territory as far north and west as Port Gravina (Birket-Smith and de Laguna 1938:18).

Non-Native use of the analysis area increased significantly at the end of the nineteenth century, as prospectors and miners came into the area to look for gold, silver, copper, and other minerals. Some of these prospectors removed artifacts and disturbed archaeological sites during the course of their occupation. An encounter with a prospector in Cook Inlet by de Laguna describes the looting of a site in Port Gravina where numerous unique stone artifacts were removed (de Laguna 1956: 24).

In addition to the currently inventoried sites, the background literature for the analysis area suggests that numerous cultural sites of both historic and prehistoric nature are present. The sites included in this analysis are those known and recorded at the present time. Future field investigations will likely reveal additional historic and prehistoric cultural resources.

Sites are typically categorized by site type and association. Categories include native association, subsistence related, mining related, fox farms, cabins and buildings (including ruins), engineering (Federal Aviation Administration or Coast Guard related), exploration, and other. Since this landscape assessment is available to the public and due to the sensitive nature and proprietary site location, sites are not identified within a table or map for the purposes of this report. However, this information is on record with the Forest Service and with the State Historic Preservation Office (SHPO) and is available by special permission to cultural resource specialists for performing site research and field survey.



## **Socio-economic**

The management of resources and environmental conditions in the analysis area may affect the social and economic well being of people living in Cordova, Tatitlek, Chenega, Valdez, and other forest users. The affected borough/census areas are described in the FEIS for the Forest Plan in Chapter 3, pages 3-508 to 570 (USDA FS 2002a), and includes the Valdez-Cordova Census Area. The Valdez-Cordova census area contains about 1% of the state's population and has a population density of 0.3 persons per square mile of the area as a whole, due to the large amount of federal land and the lack of road access to communities within the census area (Crone et al. 2002). This census area experienced population declines during the recession of the mid-1980s and had a slower recovery than the Anchorage or Kenai Peninsula census areas (Crone et al. 2002). Anchorage residents may use the area for a variety of recreational activities as sea kayaking, fishing, hiking, or boating.

Cordova, Tatitlek, and Valdez residents may use localized areas for a variety of economic, recreation and subsistence purposes. In general, the smaller communities in Prince William Sound depend to some degree on resources from the forest and riverine environment for employment, recreation, and subsistence. Lifestyles are characterized by remote living conditions, seasonal and cyclical employment opportunities, and escape from the problems of crime, crowding, noise, and pollution often associated with urban environments. Table 2.7 displays the vital statistics for these communities, along with the statistics for the State of Alaska and the Nation as a whole, based on the 2000 US Census Bureau information.

**Cordova** – The home rule city of Cordova is located 62 air miles southeast of Valdez on Orca Inlet in eastern Prince William Sound on the mainland. No roads connect Cordova with the rest of Alaska; however it is accessible by the state ferry system and commercial jet service. A new fast ferry provides daily service between Whittier, Valdez, Tatitlek, Chenega, and Cordova.

Cordova's population has been relatively stable. The 2000 census estimated 2454 people lived in Cordova. It has a significant Eyak Athabascan population with an active Village council. Commercial fishing and subsistence are central to the community's culture. Residents of Cordova rely heavily on the adjacent land and marine environment for recreational activities such as boating, camping, sightseeing, and subsistence harvest of a large variety of species.

The principal economic sector for Cordova is commercial fishing and seafood processing due to its proximity to prime fishing grounds which supports a large fishing fleet and several fish processing plants. In the past, over 50% of the community's employment was directly related to commercial fish harvesting and seafood processing. Today, the community is more diverse; other sectors of the economy include transportation, communication and utilities, construction, retail trade and services, and local, state, and federal government. Nearly half of all households have someone working in commercial harvesting or processing and 343 residents hold commercial fishing permits. Red salmon, pink salmon, silver salmon, king salmon, herring, halibut, bottom fish, and other fish are harvested. Reduced salmon prices have affected the economy. The harbor accommodates 850 vessels.

**Table 2.7 - Census Year 2000 Vital Statistics for nearby communities.**

	<b>Cordova</b>	<b>Tatitlek</b>	<b>Valdez</b>	<b>Alaska</b>	<b>Nation</b>
<b>Population:</b>	2,454	107	4,036	626,932	281,421,906
1990-2000 % pop. change	+16.3*	-10.1	-0.8	14.0	13.2
Pop. density (persons/mi <sup>2</sup> )	40.0	14.7	18.2	1.1	94.7
Size –miles <sup>2</sup>	61	7	222	671,951	3,536,338
<b>Demographics:</b>					
Male : Female Ratio	1.2	0.9	1.1	1.1	1.1
Mean Age	34.0	32.4	32.1	29.3	35.3
% Am. Indian-AK Native	11.1	84.9	7.5	16.5	0.9
% 4-yr College Educated	21.4	3.6	21.9	24.7	24.4
<b>Households:</b>					
% Same house as 5 yrs ago	58.0	72.7	45.1	46.2	54.1
% Family Households	62.4	76.3	69.8	68.7	68.1
% Owner Occupied	52.3	40.4	64.9	62.5	66.2
Median Household Income	\$50,114	\$36,875	\$66,532	\$51,571	\$41,994
% Families below poverty level	4.3	17.9	5.0	6.7	9.2
<b>Employment and Income:</b>					
% Civilian Labor Force	4.6	4.2	4.5	6.1	3.7
Unemployed					
% Private Wages/ Salary	52.9	48.6	70.1	64.9	78.5
% Government	28.7	40.0	21.8	26.8	14.6
% Self-employed	17.6	4	8.0	8.0	6.6
% Unpaid family worker	0.9	0	0.1	0.3	0.3
% Employed in Agriculture	14.1	8.6	5.4	4.9	1.9
Forest/Fishing/ Mining					
% Employed in Arts/Enter /	6.3	5.7	18.9	8.6	7.9
Accomm. /Food Services					
% Income with retirement,	+4.9	30.3	+1.1	1.9	1.9
change from 1990	8.1 to 13.1	0 to 30.3	10.9 to 11.9	12.8 to 14.7	15.6 to 16.7

\* Cordova city limits expanded from 5 mi<sup>2</sup> to 61 mi<sup>2</sup>

**Tatitlek** – Tatitlek is 30 air miles northwest of Cordova on the northeast shore of Tatitlek Narrows on the mainland. It is a coastal Alutiiq village of 107 residents (2000 census) with a culture based on fishing and subsistence. The sale or importation of alcohol is banned in the village. Access is provided by the state ferry, chartered aircraft, and by boat. Fish processing and oyster farming provide some employment in Tatitlek. Four residents hold commercial fishing permits. Subsistence activities provide the majority of food items. A coho hatchery at Boulder Bay is nearing completion for subsistence use. A fish and game processing facility is under construction. A small community store has recently opened. As measured by the Shannon Weaver diversity index, employment in Tatitlek is somewhat less diverse than the state and nation as a whole. It is more diverse than Chenega, but less diverse than the other communities in the area. Ellamar is a small community adjacent to Tatitlek on Valdez Narrows. It is accessible by boat and connected to Tatitlek by road (Fig. 2.19).

**Valdez** – The home rule city of Valdez, population 4036, is located on the north shore of Port Valdez, a deep water fjord in Prince William Sound. It is 305 road miles east of Anchorage and 364 miles south of Fairbanks. The state ferry, commercial and chartered aircraft, boats, and a highway provide access to Valdez. During the 1964 earthquake, a slide of unstable submerged land destroyed the original city waterfront killing several residents.

The community was rebuilt on a more stable bedrock foundation 4 miles to the west. It is the southern terminus of the Trans-Alaska oil pipeline. As a result of significant oil taxation revenues, the city offers a variety of quality public services. Valdez has one of the highest municipal tax bases in Alaska due to the oil terminus. Four of the top ten employers in Valdez are directly connected to the oil terminus. Valdez is a major seaport with a \$48 million cargo and container facility. City, state, and federal agencies combined provide significant employment. Seasonal commercial fishing and tourism have spurred the retail and service sectors. In 2006, there were 50 registered charter vessels and 44 charter businesses. Forty-two residents have commercial fishing permits. In 2002, 27 cruise ships docked in Valdez. It has 3 fish processing plants and a small harbor for 546 vessels.



**Figure 2.19 – View of Ellamar, photo taken August 2007.**

### **Subsistence**

Subsistence plays a major role in the lives of people who live in and near the analysis area. Ninety-four to 100% of households in Cordova, Tatitlek, and Valdez use subsistence resources (Table 2.8). While fish plays a major role as food for coastal Alaskan residents, other wildlife, namely large mammals, play an important role as well. These resources are harvested under numerous and sometimes confusing harvest seasons, managed by various jurisdictions including ADFG sport harvest, ADFG subsistence harvest, federal subsistence harvest managed by the USFWS Office of Subsistence Management (OSM), and the National Marine Fisheries Service management of subsistence halibut fishery.

During the 1986 Joint Boards of Fish and Game meetings, Prince William Sound or Game Management Unit 6 (GMU 6) was determined to be rural for purposes of subsistence uses of resources, except for Whittier and Valdez. About 6865 people (2000 census) reside in GMU 6. Excluding Whittier and Valdez, about 2647 people qualify for subsistence uses of resources in the Sound. The majority are from Cordova, Tatitlek, and Chenega.

Communities were extensively surveyed between 1985 and 1988 and again between 1990 and 1997 (communities were surveyed in different years). The ADFG Subsistence Division collected information on historic and current use patterns, harvest areas, species used,

pounds of resources collected and consumed and harvest methods. Table 2.9 displays the summary of use of subsistence resources by community. Information is from the ADFG Community Profile Database (Brown et al. 2001). Information collected in 1997 (Table 2.9), indicates that Cordova's per capita use was 179.4 lbs and Tatitlek's per capita use was 406 pounds.

**Table 2.8 - Summary of use of subsistence resources by nearby communities**

	<b>Cordova</b>	<b>Tatitlek</b>	<b>Valdez</b>
<b>All resources</b>	1997	1997	1992
% household using	97.6	100	97
% households harvesting	89.7	88	83
% households receiving	88.2	100	86
% households giving	78.7	100	68
Estimated pounds	449,841	32,915	386,078
Per capita pounds	179.4	406	103
<b>Fish (both salmon and non salmon)</b>			
% household using	93.7	100	95
% households harvesting	75.1	75	77
% households receiving	80.6	94	72
% households giving	68.4	81	62
Estimated pounds	263,712	12,858	286,399
Per capita pounds	105.2	159	77
<b>Land Mammals (both large and small)</b>			
% household using	79.0	94	62
% households harvesting	52.2	63	23
% households receiving	62.0	81	51
% households giving	47.8	38	16
Estimated pounds	136,612	3,720	71,227
Per capita pounds	54.5	46	19
<b>Marine Mammals</b>			
% household using	11.0	94	2
% households harvesting	5.1	50	0
% households receiving	7.1	75	2
% households giving	6.7	56	0
Estimated pounds	9,114	13,372	0
Per capita pounds	3.6	165	0
<b>Birds and Eggs</b>			
% household using	42.3	81	30
% households harvesting	30.4	69	26
% households receiving	18.2	63	6
% households giving	9.9	38	5
Estimated pounds	5,593	797	5,273
Per capita pounds	2.2	10	1
<b>Marine Invertebrates</b>			
% household using	51.7	81	49
% households harvesting	29.2	63	20
% households receiving	47.4	69	41
% households giving	27.6	38	14
Estimated pounds	13,844	1,509	11,915
Per capita pounds	5.5	19	3
<b>Vegetation</b>			
% household using	87.0	100	66
% households harvesting	85.4	75	60
% households receiving	42.7	63	31
% households giving	44.3	69	27
Estimated pounds	20,966	658	11,264
Per capita pounds	8.4	8.1	3.0

**Subsistence fishing** - Subsistence fishing in East Prince William Sound occurs primarily in the marine waters near the Village of Tatitlek and areas near to the City of Cordova. The largest community within the analysis area is Tatitlek with just over 100 residents. Several other bays and passes in the analysis area contain single family residents, such as Simpson Bay and Two Moon Bay. The City of Valdez with a population of approximately 4,000 people is located just north of the analysis area, but is not in the Chugach National Forest. Valdez has been identified as a non-subsistence area and the residents of Valdez do not qualify for subsistence under federal regulations. Cordova is located just to the east of this analysis area. Cordova has a population of approximately 2,300 people and the residents are qualified under federal regulations to use resources on federal lands for subsistence.

There is little documented use of fish being harvested from fresh water for subsistence in this analysis area probably because of the remote nature of the area and the small population. However, a heavy dependence of the marine resources has been documented. Salmon make up nearly 60% of the fish harvested for subsistence in Tatitlek. The remaining fish harvested for subsistence were composed of other marine species (Brown et.al. 2001). Fish species found in fresh water were not identified as being commonly used for subsistence in this community. At this time, federal jurisdiction for subsistence in this area does not include marine waters. However, as the growing urban populations of Anchorage and Valdez continue to exert pressure on the marine resources used for subsistence, rural residents of the area may shift a portion of their subsistence harvest to freshwater species to supplement their needs.

The four species of salmon commonly found in this analysis area are pink, chum, coho, and sockeye salmon. Chinook salmon are occasionally present in the marine waters, but are rare in the fresh water habitats. Pink and chum salmon are the most abundant, while sockeye salmon are the most desired for subsistence use. Some residents of Tatitlek travel to the Copper River Flats in May to harvest sockeye and Chinook salmon for subsistence under a village educational harvest permit. Some residents of Tatitlek also travel to Billy's Hole, east of the analysis area, in the summer to harvest sockeye salmon. Pink, chum, and coho salmon are harvested in the analysis area with a gillnet or rod and reel.

A coho salmon smolt stocking program had been in place until 2004 in Boulder Bay, which is east of the Village of Tatitlek. These salmon smolt were provided by the Valdez Fisheries Development Association's Solomon Gulch salmon hatchery. Approximately, 20,000 coho salmon smolt were released into the bay each year to provide a salmon return to the area for public use including subsistence (Jason Wells 2006. per. comm.). The returning adult salmon provided the residents of Tatitlek a supplemental source of salmon close to the village. These fish were also available for other uses such as sport and commercial fishing. However, the more abundant coho salmon returns to the hatchery in Valdez attracted most of the fishing effort and little interest developed in Boulder Bay. This stocking program ended because of the lack of interest and because most of the residents of Tatitlek had already acquired sufficient salmon for the season by the time these coho salmon returned.

The sport harvests of coho, sockeye, chum, and pink salmon that occur in this area are usually close to the mouths of streams in the intertidal areas although some trolling for winter Chinook and fall coho salmon occurs. Some sport harvest of cutthroat trout and Dolly Varden occurs in the freshwaters, but nearly all of the recreational anglers are people that fly or boat in from urban areas for a few days to fish.

Subsistence harvest of butter clams (*Saxidomus giganteus*), and Pacific littleneck clams (*Protothaca staminea*), occurs on some of the beaches in this analysis area. These beaches are accessible by residents using small boats. The clams are found in the intertidal zone and vary in density. The State of Alaska regulates the clam harvest in this area and although there is no closed season or harvest limits for clams the state does not certify the beaches to be free from paralytic shellfish poisoning (Robert Berceli, ADFG shellfish biologist, personal communication 2006).

The subsistence harvest of herring and herring roe occurs near Tatitlek each spring. At the present time, the herring stocks in the Sound are at low levels. However, the stocks near Tatitlek still provide an opportunity for subsistence harvest. If the herring stocks rebound and a commercial fishery is re-established, conflicts between commercial and subsistence harvesters could occur and some protection of the subsistence harvest may be needed.

Future subsistence harvest in this analysis area is expected to grow slowly as the populations of Tatitlek and Cordova increase. Currently, the subsistence harvest of salmon is done in marine waters adjacent to this analysis area. The harvest of salmon in fresh water is allowed with a federal subsistence permit or with a state sport fishing license. There is a potential for increased competition between subsistence users and sport anglers in the future. The sport fishing industry in Valdez and Cordova is growing and may impact subsistence use in the areas near Tatitlek and Cordova.

Residents of Tatitlek use freshwater fish species very little for subsistence, probably because the marine resources are abundant and meet their subsistence needs. The ability of these freshwater fish stocks to meet subsistence needs is unknown. Little or no data is available on population sizes, ranges or habitat carrying capacities. Population studies are needed to determine the exploitation rate that could take place on trout and other freshwater species and still maintain a sustainable harvest.

**Sport and subsistence hunting** - The analysis area is primarily located in GMU 6D (although small portion of 6C and 12D are included). The subsistence harvest quota in this area is 17 mountain goats divided among 6 hunt areas within GMU 6D. The hunting season for the federal subsistence harvest is open from August 20 to January 31.

For GMU 6D, the hunting season for all bear hunters is October 15 to May 25 with a bag limit of 1 bear every 4 regulatory years (ADFG 2005). Taking cubs (bears  $\leq 2$  years) or a female accompanied by cubs was prohibited. For GMU 6D, hunting harvest was 6 bears during 2002-03 and 19 bears during 2003-04 (ADFG 2005).

Sitka black-tailed deer have been hunted in the Prince William Sound area since 1935 and are the big game species with the highest sport and subsistence hunting use in the State of Alaska. Population trends are monitored cooperatively by the USFS and ADFG. Although a majority of the deer population is on the large islands in Prince William Sound, mainland areas and small islands in the analysis area are also populated by deer.

The five-year trend for Sitka black-tailed deer harvest in the Prince William Sound area has been upward, with the highest harvest coming from Montague Island (ADFG 2001, 1999a). Due to consecutive mild winters, Sitka black-tailed deer numbers in the Prince William Sound area are considered to be moderate to high, and show a general trend of increase. Severe winters occasionally reduce populations (ADFG 1999b). Currently, state bag limits in GMU 6 allows the harvest of 5 deer by state residents. Hunting begins on August 1 and ends on December 31. Does may be harvested after October 1. The small islands adjacent to Tatitlek are an important subsistence hunt area and should be considered when making any management decisions in the area.

### **Timber harvest and roads**

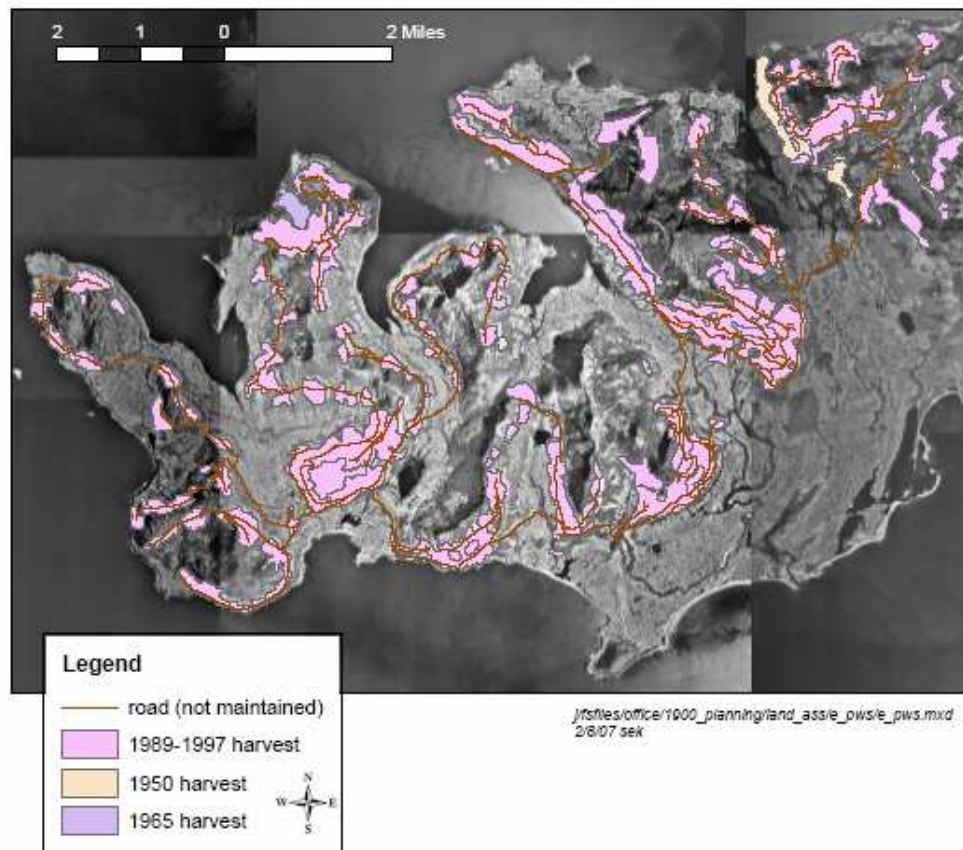
No federal, state, or forest roads exist in the analysis area. Access is by air or sea. Timber has been harvested for both commercial and personal use in the analysis area. Historical timber harvest records indicate that scattered harvest occurred on National Forest System lands from 1947 to 1964 in Fish Bay, Galena Bay, Irish Cove, Snug Corner Cove, St Mathews Bay, Alice Cove, Sheep Bay, and Simpson Bay. Total acreage is estimated to be less than 500 acres. No commercial harvest has occurred on National Forest System lands since then. Several of the sales were individual tree select harvest. Scattered harvest also occurred in support of mines, fox farms, canneries, and for personal use.

The Tatitlek Corporation established ownership of the Knowles Head and Fish Bay areas through the Alaska Native Claims Settlement Act (ANCSA). The areas were selected in 1975 and subsequently transferred to the Corporation. The Corporation managed both areas as industrial forestland until 1997. In the Fish Bay area, the Corporation harvested 1100 acres and built 18.5 miles of road. The roads are not maintained. The Corporation also constructed 91 miles of roads and harvested timber from 6015 acres between 1989 and 1996 on the Knowles Head Peninsula, (Fig. 2.20). Approximately 24% of the forested acres were harvested in 8 years (USDA Forest Service 2007b). Most culverts and bridges have been pulled and alder, trees, and shrubs have revegetated the road beds.

Lands in these areas were subsequently conveyed either fee simple to the National Forest system or subjected to conservation or timber easements. Details of the harvest and roading on Knowles Head Peninsula are described in the Knowles Head Restoration Plan completed August 23, 2007 by the Cordova Ranger District (USDA Forest Service 2007b).

Prior to 2002, the Eyak Corporation managed their lands between Nelson and Simpson Bays as industrial timber lands and harvested approximately 485 acres of timber and built 16.3 miles of road.





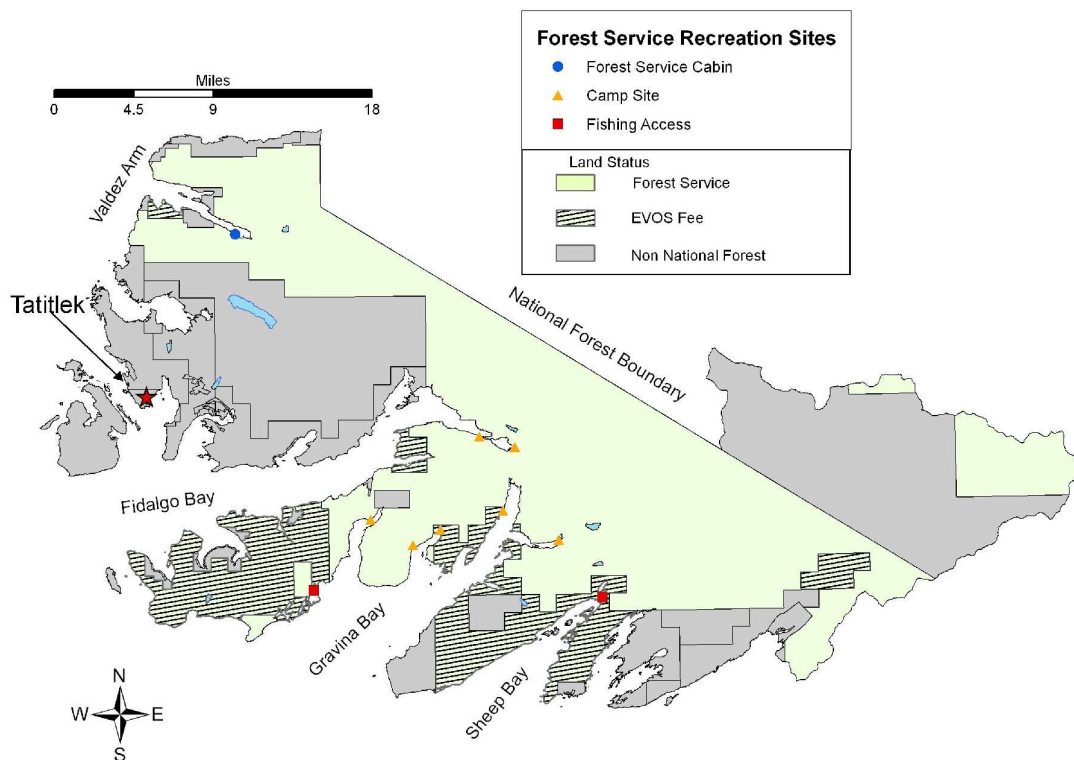
**Figure 2.20 – Location of harvest and roading on Knowles Head Peninsula between Port Fidalgo and Port Gravina.**

### **Recreation Use and Facilities**

The East Prince William Sound analysis area is generally undeveloped, has high scenic value, and provides the opportunity for recreation in a primitive and remote setting with plenty of solitude. Recreational development is limited to one public recreation cabin in Jack Bay and a combination of Class I & III easement trails (Figs. 2.21 through 2.23). These trails and the natural features of the analysis area provide a variety of recreation activities including; kayaking, boating, hiking, hunting, wildlife viewing, fishing, camping, and sight seeing. Motorized use for recreation purposes is not allowed on National Forest System lands in the majority of the analysis area. One small area at the mountain peaks at the headwaters of Rude River is open to use by helicopters in the summer and snowmachines and helicopters in the winter.

With the Whittier tunnel open to vehicular traffic and high speed ferry service, access to the Sound by independent and commercial users has increased (USDA Forest Service 2007c). The Alaska Department of Community and Economic Development noted that as traditionally popular tourist destinations in Southeast Alaska and at Denali have become more crowded, Prince William Sound is one of the areas identified as the next frontier of the tourism industry ([www.commerce.state.ak.us/dca/AEIS/AEIS\\_Home.htm](http://www.commerce.state.ak.us/dca/AEIS/AEIS_Home.htm)). Other research seems to bear out the State's prediction. The heavily cited work of David Brooks and

Richard Haynes on recreation and tourism trends in Southcentral Alaska along with J. M. Bowker's predictions of outdoor recreation by Alaskans suggests this "frontier" has been discovered (USDA Forest Service 2007c).



**Figure 2.21 - Location of recreation sites in the analysis area**

An administrative cabin is located near the head of Olsen Bay on the north shore (39 miles from Cordova by boat or 20 minutes by floatplane). A boat house was converted into a living facility after the 1989 *Exxon Valdez* Oil Spill to house Alaska Department of Fish & Game employees conducting post spill research. The Forest Service has used the facility for various projects over the past 20 years but not consistently.

The Jack Bay Cabin (Fig. 2.22) located near the head of Jack Bay off Valdez Narrows is accessible via floatplane (15 minutes from Valdez or 40 minutes from Cordova) or boat (20 miles from Valdez or 74 miles from Cordova). This 12x14 ft. Pan Abode cedar log cabin was built in the mid 1960s. The cabin has an oil stove and sleeps a maximum of six people. Recreation opportunities include fishing, big game and waterfowl hunting, camping, and viewing wildlife and scenery. Most of the use occurs in the spring and fall during bear and goat hunting seasons and again during the salmon season. Use fees are \$35.00/ night.



**Figure 2.22 – Jack Bay Cabin, photo taken August 2007.**

### **Easements**

With the passage of ANCSA in 1971, the Forest Service and other federal agencies in Alaska were to establish trail, site, and road easements across the new private land holdings in order to provide public access to isolated parcels of public land. These site and trail easements are called 17(b) easements, a reference to section 17(b) of ANCSA. The federal agencies administer the 17(b) easements within their jurisdiction, and the BLM is responsible for the recording, final platting, and rule making. Trail easements are intended only for accessing public lands; they may not be used as hiking trails or for any other purposes unless authorized by the landowner. Similarly, site easements may be used for day use or overnight camping if the user either intends to access public lands from the site or it is adjacent to navigable waters. Any changes to the legal reserved locations require consultation with the affected Native Corporation.

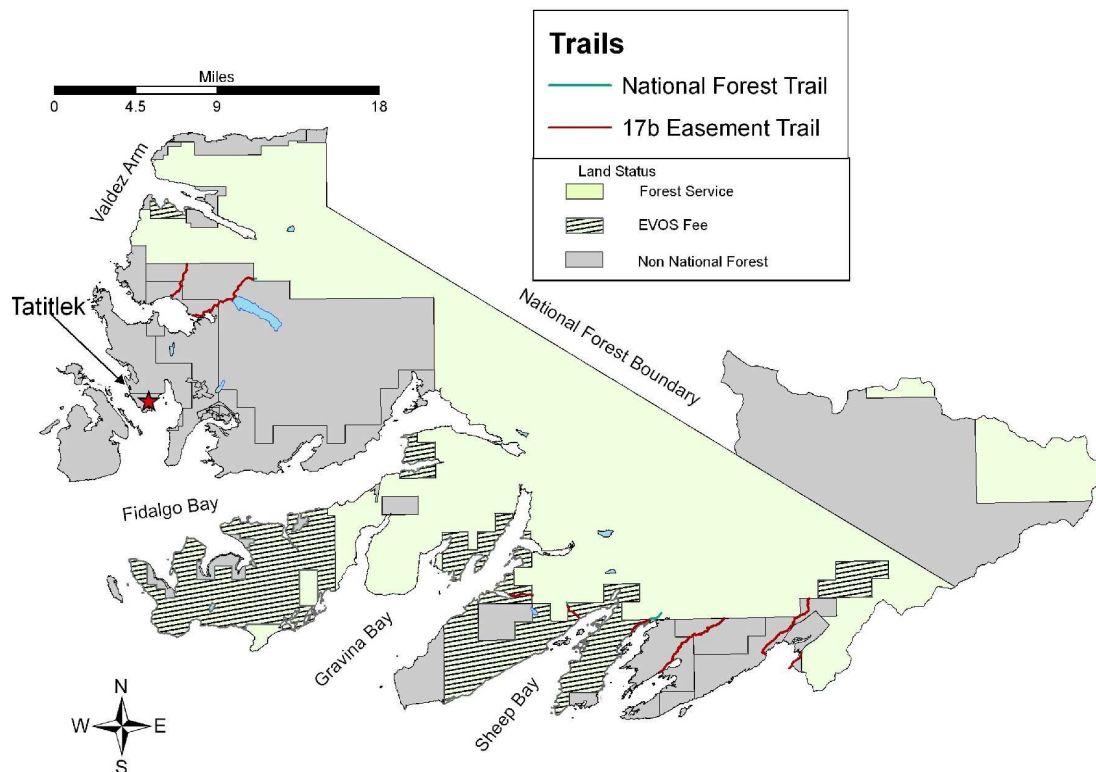
The 1982 Settlement Agreement between Chugach Natives Inc. (CNI), now Chugach Alaska Corporation (CAC), and the Chugach National Forest established streamside, site, and trail easements similar to 17(b) easements, except that these easements were specifically for recreation purposes. Access beyond the trail corridor is not allowed without a corporation permit. These easements are commonly referred to as CNI easements.

The specific uses allowed on the easements depend on the easement type. On 25-foot right of way trails, travel by foot, dogsleds, animals, snowmobiles, two and three-wheeled vehicles, and small off-highway vehicles (OHVs) less than 3,000 lbs gross weight is allowed. On one-acre sites, vehicle parking (e.g. aircraft, boats, snowmobiles, OHV, cars, or trucks), temporary camping, loading or unloading is limited to 24 hours.

Streamside easements comprise the area of land constituting the bed and banks and area 50 feet upland of the Ordinary High Water mark on both sides of the stream unless otherwise designated by agreement.

United States Coast Guard (USCG) navigational aid site easements are present on Tatitlek Corporation lands for the Goose Island (EIN 107J), Busby Island (EIN 103J) and Rocky Point (EIN105J) lights. The Busby Island light also has access easements (EIN105J and EIN106J). These navigational aid easements are typically circular varying in size depending on the ground conditions to ensure safe access to the site. They include an airspace easement with an arc of access equal to the site easement but specific to the range of view from which the navigational aid can be seen by vessels. The allowable uses include those associated with construction, reconstruction, operation maintenance, the right to clear and keep lands clear from any obstruction infringing upon or penetrating the airspace, the right to remove buildings or obstructions of any type which may infringe upon or extend into the airspace, and the right to prohibit use on and removal from the lands beneath the airspace any objects which would create interference for users of the navigational aid. Use is limited to the United States Government and its authorized agents, contractors, and assigns.

The trail easements are displayed in Figure 2.23. The majority of trail and site easements are well marked. However, a number of easements which were originally reserved within areas previously conveyed to the Eyak and Tatitlek Corporations and reacquired through the EVOS settlement are not marked since these lands are now National Forest System lands and open to public access. The easement reservations are retained by the Forest in the event of any future change in land ownership.



**Figure 2.23 - Location of 17(b) trail easements in the analysis area.**



<b>Table 2.9 - Easement trails and sites in the East Prince William Sound analysis area.</b>			
<b>Name &amp; Length (mi)</b>	<b>Easement ID</b>	<b>Land Owner</b>	<b>Comments</b>
<b>Trails</b> (Cordova RD office has detailed maps for site and easement locations.)			
Shepard Pt. (1.1 mi)	EIN 114bG	Eyak Corp	Nelson Bay
Rude River South (1 mi)	EIN 113aG	Eyak Corp	Nelson Bay
Rude River North (5.4 mi)	EIN 112aG	Eyak Corp	Nelson Bay
Robinson Falls	EIN 111G and 35G	Eyak Corp	To be relinquished - no longer needed
Raging Creek (3.8 mi)	EIN 110aG & 36 C4 D1	Eyak Corp	Simpson Bay (south arm)
Upper Raging Creek (3.1mi)	CNI15	CAC	Continuation of EIN 110aG
Simpson Bay North	EIN 109dG	Eyak Corp	Simpson Bay (EVOS reserved)
Koppen Creek	EIN 108gD9G	Eyak Corp	Sheep Bay (EVOS reserved)
Sahlin Lagoon	EIN 108eD9G	Eyak Corp	Sheep Bay (EVOS reserved)
Sahlin Lake	EIN 108G	Eyak Corp	Sheep Bay (EVOS reserved)
Comfort Cove (1.5 mi)	EIN 233D1	Eyak Corp	EVOS Reserved
Comfort Creek	CNI 17	CAC	On EIN 107aG
Hells Hole	EIN 118G	Tatitlek Corp	EVOS Reserved
Snug Corner Cove	No number	Tatitlek Corp	EVOS conveyed
Gravina River	EIN 227 G	Eyak Corp	EVOS Reserved
Indian Creek (1.3mi)	EIN 4a D9 G	Tatitlek Corp	Galena Bay
Narrows Tr (Indian Creek)	CNI 13	CAC	Continuation of EIN 4a D9G
Duck River (Silver Lk) 2.6 mi	EIN 29aG	Tatitlek Corp	Galena Bay
Silver Lake (4.6mi)	CNI 14	CAC	Continuation of EIN 29aG
Two Moon Bay Tr.	CNI 16	CAC	Continuation of EIN 20aG
South Rude River Tr.	CNI 18 & 0G,C5	CAC	To be relinquished
<b>Sites</b>			
Shepard Pt. (0.92 ac)	EIN114cG	Eyak Corp	Nelson Bay
Rude River South (1 ac)	EIN 113G	Eyak Corp	Nelson Bay
Rude River North (0.9 ac)	EIN 112G	Eyak Corp	Nelson Bay
Rude River Site	CNI 19	CAC	To be relinquished
Raging Creek (0.5 ac)	EIN 110G	Eyak Corp	Simpson Bay (south arm)
Robinson Falls	EIN 111aG	Eyak Corp	To be relinquished no longer needed
Simpson Bay North	EIN 109cG	Eyak Corp	Simpson Bay (EVOS reserved)
Koppen Creek	EIN 108fd9G	Eyak Corp	Sheep Bay (EVOS reserved)
Sahlin Lagoon	EIN 108dG	Eyak Corp	Sheep Bay (EVOS reserved)
Sahlin Lake	EIN 108aG	Eyak Corp	Sheep Bay (EVOS reserved)
Port Gravina	EIN 107b C4	Eyak Corp	P. Gravina
Comfort Cove (0.8 ac)	EIN 232D1	Eyak Corp	EVOS Reserved
Snug Corner Cove	EIN 21 C4	Tatitlek Corp	EVOS Conveyed
Gravina River	EIN 226 G	Eyak Corp	EVOS Reserved
Indian Creek (1.05 ac)	EIN 4b D9 G	Tatitlek Corp	
Silver Lake (1.05 ac)	EIN 14a	CAC	
Galena Bay (0.20 ac)	EIN 29bG	Tatitlek Corp	

Typically trail and site easements are surveyed and marked with a mixture of signs, carsonite posts, orange plastic diamonds, and chainsaw blazes on trees over 6" in diameter along the trail. Corner monuments are placed at sites and at the beginning and ending of the easements. Easement sites are normally marked and cleared to 1 acre or less and located as near as possible to the legal reservation while taking into account ease of public access and

availability of fresh water and well drained, flat terrain for camping. Easement trails are cleared to a six-foot width with an 8-foot high clearing limit, without a tread, and designed to 20% grades or less wherever possible.

**Silver Lake Easement** - This 4.6 mile long easement trail is located at the eastern end of Galena Bay on the north side of Duck River near the entrance to the lagoon. Galena Bay is approximately 15 miles north of Tatitlek and 30 miles south of Valdez. The easement was cleared and marked during the summer of 1996 and maintained in 2007. The trail's remoteness and class I classification has placed it low on the funding list.

**Indian Creek Easement** - This 1.3 mile easement trail is located at the north side of Galena Bay on the east side of Indian Creek. The easement was cleared and marked during the summer of 1996 and maintained in 2007. The trail's remoteness and class I classification has placed it low on the funding list.

**Comfort Cove Easement** - This 1.5 mile long trail is located on the northeast side of Comfort Cove on the southeast side of Port Gravina. Port Gravina is about 30 miles north of Cordova and 35 miles south of Valdez. The easement was cleared and marked during the summer of 1995. It has not been maintained since then because its remoteness and Class I classification has placed it below the funding level.

**North Rude River Easement** - This 5.4 mile long trail is located on the north side of Nelson Bay. Nelson Bay is 12 miles north of Cordova. The easement was cleared and marked during the summer of 1985, again in 1996, and was completed in 2005. It has not been maintained since then due to its remoteness and Class I classification.

**Ragging Creek Easement** - This 3.8 mile long trail is located on the northwest side of the southern arm of Simpson Bay. Simpson Bay is about 20 miles northwest of Cordova. The easement was cleared and marked during the summer of 1985 and again in 1995. It has not been maintained since then due to its remoteness and Class I classification.

### **Special Uses**

Eleven special use authorizations for consumptive and non-consumptive outfitter/guide activities and other uses exist in the analysis area. One to three short term film permits have been issued within the analysis area as well but they are not listed here as the use is short and temporary. The following organizations or groups are authorized use of the National Forest System lands within the analysis area:

**University of Alaska, Fairbanks (UAF) (COR 30)** - The UAF Geophysical Institute's earthquake research project involves conducting geodetic surveys and monitoring at 25 locations in Prince William Sound. Seven of the permitted sites are within the analysis area.

**University of Alaska, Fairbanks (COR 105)** - The UAF School of Fisheries and Ocean Sciences has a research project to monitor and record the dynamics of ocean currents and circulation within Prince William Sound. One of the research monitoring stations is located within Knowles Bay.

**United States Coast Guard (GLA000213)** - The Coast Guard is authorized several navigational aids within the analysis area (Goose Island, Busby Island and Rocky Point lights) and a communications site at Potato Point in the Valdez Narrows.

**Babkin Charters (GLA101)** - The permit holder is authorized to conduct guided and unguided day hikes, shore and stream fishing, and low impact camping in Jack Bay and Port Gravina.

**Auklet Charter Services (GLA264)** - The permit holder is authorized use within numerous locations throughout Prince William Sound on the Glacier and Cordova Ranger Districts for conducting guided day-use hikes. Areas within the analysis area include Beartrap Bay, Olsen Bay, Saint Mathews Bay, Port Fidalgo, and Comfort Cove.

**Ed and Deb Stevenson (COR139)** - The permit holder is authorized an ANILCA shelter within Port Gravina under ANILCA 1316(a).

**Woods Outfitting, Sheep River Hunting Camps, Alaska Mountain Safaris, Acord Guide Service, and Lonesome Dove Outfitters** - The Cordova District currently authorizes these five big game hunting guides to operate within the analysis area. Species hunted include brown bear, black bear, and mountain goat.

## **Minerals**

Types of minerals administered by the Forest Service include locatable minerals (36 CFR 228, Subpart A), salable minerals (38 CFR 226, Subpart C), leasable minerals (36 CFR 228, Subpart E), and reserved and outstanding minerals (36 CFR 251.15, FSM 2830). Both locatable minerals claimants and operators (under the 1872 Mining Law), and reserved and outstanding minerals owners, have a statutory right to develop the mineral resource. The disposal of salable minerals (minerals materials) and leasing of the leasable minerals (includes oil, gas and coal; as well as hardrock minerals on acquired lands) are discretionary actions. The Forest Service may determine whether to offer a mineral materials sale and administer disposal under the salable regulations cited above.

**Locatable Minerals** – The Forest has no approved mining plans of operations within the analysis area, nor have any been submitted for approval.

The U.S. Geological Survey assessed the mineral resource potential for the Chugach National Forest for the Forest Plan revision (Nelson and Miller 2000). The report focused strictly on metallic mineral resources. It did not cover leasable resources such as coal, oil and gas, or salable resources such as common variety rock, gravel, and sand. The four deposit types evaluated are as follows: 1) Cyprus-type massive sulfide (copper, lead, zinc, gold and silver); 2) Chugach-type low-sulfide gold quartz veins (gold and silver); 3) placer gold; and 4) polymetallic veins (copper, zinc, lead, gold and silver) (Figure 2.24).



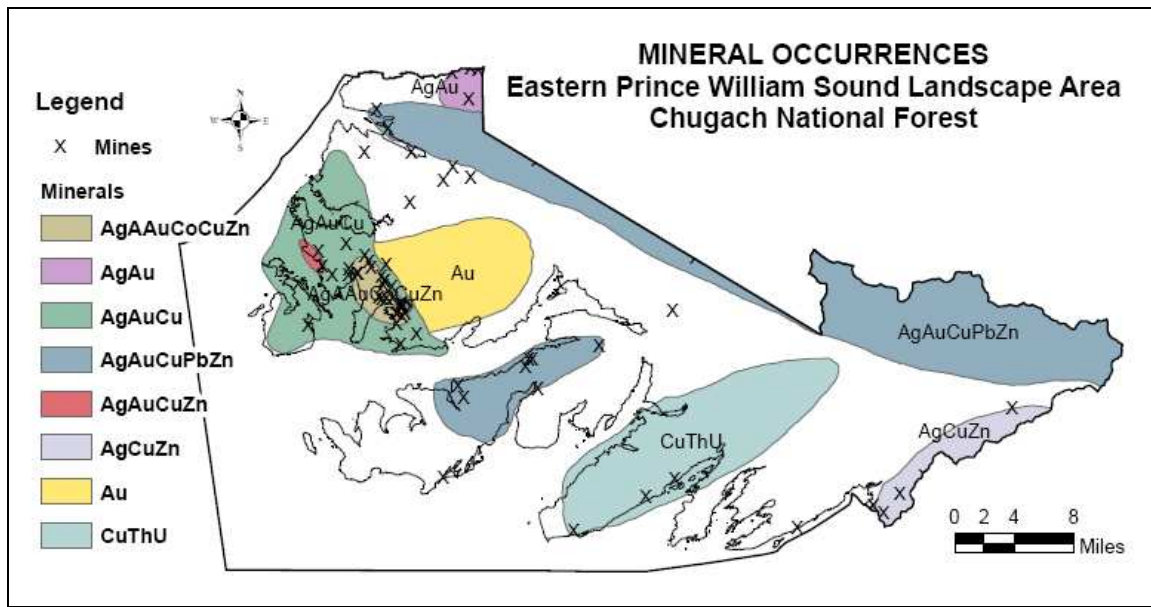


Figure 2.24 – Mineral occurrences in analysis area.

#### *Undesignated and Unevaluated Tracts*

More than half of the analysis area is unevaluated (area in white, Figure 2.25). These tracts lack history of production, lack diagnostic geologic criteria, do not fit deposit type models, or have so low of a tonnage and grade to be considered significant.

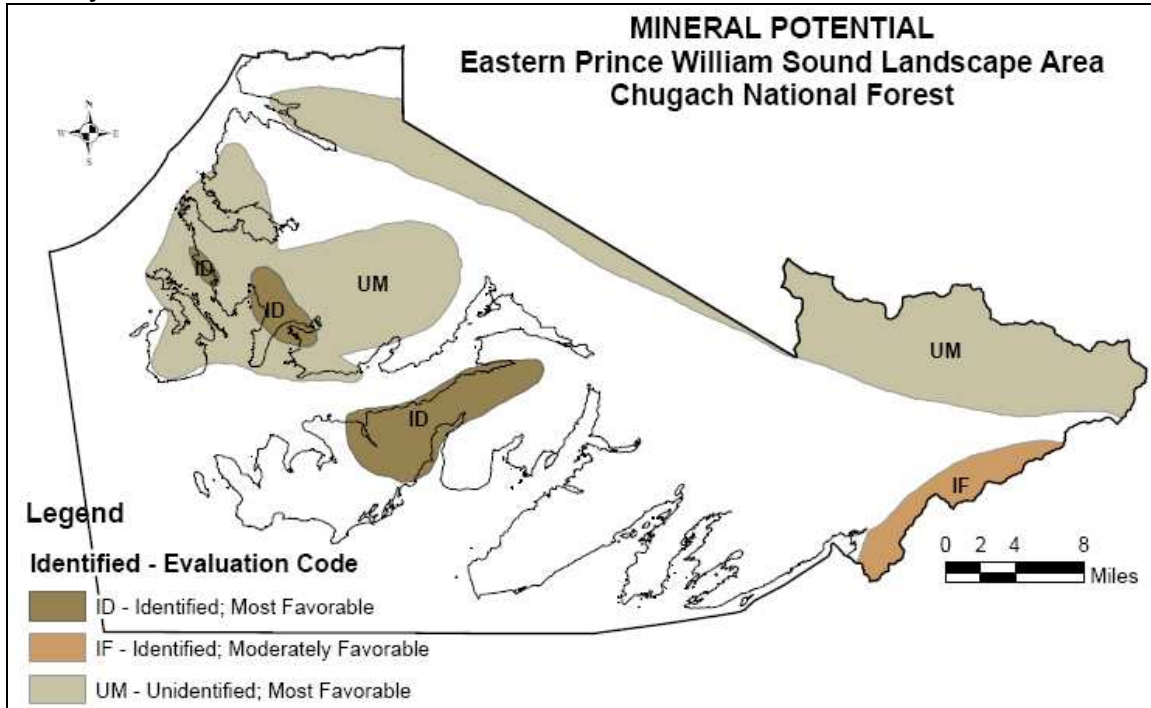
#### *Prospects and Occurrences*

There are three resource locations in or immediately proximal to National Forest System lands of the analysis area that have had significant production of copper which includes the following: Fidalgo Mining Co., 360,376 pounds copper; Dickey Copper Co., 29,346 pounds Copper; and Schlosser, 4,160,820 pounds of copper, 1,384 oz silver (Jansons, et al., 1984). In addition there are other mines with lesser or unknown production and other prospects across the analysis area however most are north of Port Fidalgo on private lands.

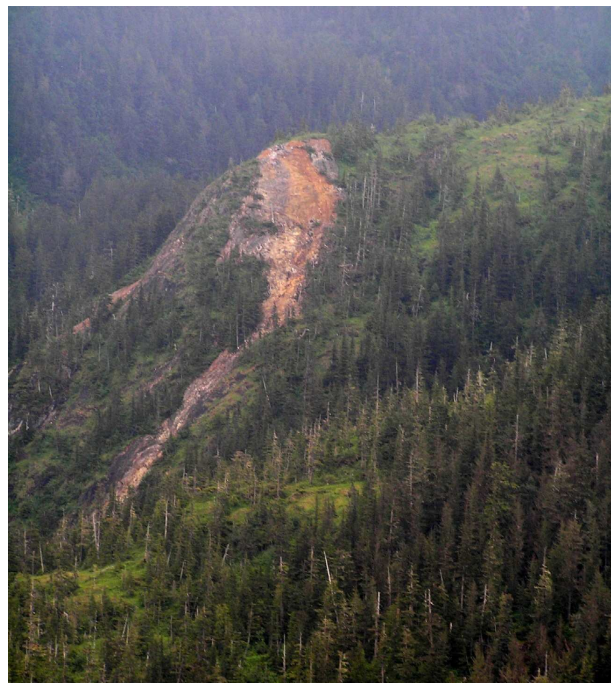
There are places in the analysis area that have identified mineral resources and are highly favorable for future mineral development (shown in dark brown in Figure 2.25) and also areas with no identified mineral resources but are highly favorable for future mineral development (shown in light tan in Figure 2.25). The analysis area is considered to be relatively unexplored for mineral resources, but the geology is favorable for the occurrence of certain types of mineral deposits.

**Salable Minerals (Mineral Materials, Common Variety Minerals)** - According to the geology map significant Quaternary deposits (sand and gravel) occur within the analysis area. There are abundant resources of rock that could be used for general fill and road construction purposes. The potential for high quality crushed rock, rip rap and armor stone is unknown, however massive metagraywacke deposits are known to have produced quality crushed rock, rip rap and armor stone in other areas. The remoteness of the area will likely preclude development of these resources in the near future other than for in-service trail construction and maintenance.

**Leasable Minerals** - There is low or no potential for oil and gas, and coal deposits within the analysis area.



**Figure 2.25 – Mineral resource potential of analysis area. (Nelson & Miller 2000)**



**Figure 2.26 – Old mine tailings east of Irish Cove in Fidalgo Bay, August 2007.**

## Research Natural Area

The Olsen Bay Creek RNA is located in Port Gravina. It supports a diversity of vegetation types representative of the Sound's mountainous coastal range. The boundary encompasses most of the Olsen Bay Creek watershed, connecting shoreline to ridge tops on both sides of the bay (Fig. 2.27). The interior basin is mostly forested, and is rimmed by a combination of mountain peaks and rocky ridgelines. The mountaintops are snow covered much of the year. The West and East Forks of Olsen Bay Creek drain most of the area. The streams flow freely without convergence to the tidal area of Olsen Bay. All of the lands in the RNA are under federal administration and total 6,850 acres. Primary human uses of the area have been for fisheries research and bear hunting (USDA Forest Service 2007a).



Figure 2.27 – Location of Olsen Bay Creek Research Natural Area.

Olsen Bay and the adjacent land area have hosted extensive research on various natural resources. Research topics have included anadromous fisheries (Helle 1966), black bears (Frame 1974), sea otters, glaucous-winged gulls (Moyle 1966), and aquatic invertebrates. Much of this research has occurred within or immediately adjacent to the Olsen Bay Creek

RNA. Datasets span more than 50 years and reflect efforts of multiple agencies, universities, and other research organizations. The area provides invaluable baseline and reference materials to which datasets in future time and similar places can be compared (USDA Forest Service 2007a).

The establishment record for the Olsen Bay Creek RNA (USDA Forest Service 2007a) states that there are no known uses within the RNA that conflict with the RNA management prescription (see pages 4-30 and 4-31 of USDA Forest Service 2002c). The establishment record contains a full description of the area and the rationale for its designation.

## Chapter 3 – Issues and Key Questions

Following are the key issues and questions raised for the area. Information addressing these issues and key questions is provided in Chapter 2 and Chapter 4. Chapter 5 includes potential monitoring projects to answer the questions if there are data gaps and other potential projects. In general, most change in the area is naturally caused, either by tectonic activity or weather. Glaciers played a major role in shaping the landscape. Some timber harvest and road building has occurred, but those effects are diminishing as natural plant succession progresses and slopes reach their natural angle of repose. Trees are regenerating harvested areas adequately. However, in the summer of 2007, a major outbreak of black-headed budworm occurred that caused extensive defoliation of hemlock and spruce.

### **Physical**

1. ***Is soil or bank erosion an issue in the area? How do recreational uses currently affect streambank erosion, channel morphology, and water quality in the analysis area, and what impacts will increased uses have on these hydrologic processes?***  
Currently, recreational uses in the Eastern Sound area have only minor effects on streams, stream banks, and water quality. However, it is expected that these uses will increase in the future. Low gradient streams along the coasts with delicate streambanks can be heavily impacted by trampling in popular areas that receive the most use. An area of concern is Hell's Hole which is a popular sport fishing destination, however current use is not causing damage to the stream banks, but the area should be monitored to ensure damage does not occur.
2. ***What effects have the past harvest operations on the Knowles Head Peninsula had on hydrologic processes?*** Logging on the Knowles Head Peninsula prior to conveyance to the Forest Service entailed numerous clearcuts and logging roads. Landslides, soil erosion, and altered stream courses have caused sedimentation in anadromous streams and degraded aquatic habitats. Natural regeneration as well as restoration efforts by the Chugach National Forest over the past decade have lessened these impacts. The *Knowles Head Restoration Plan* was completed in 2007 (USDA Forest Service, Chugach National Forest, 2007) to examine the need for additional restoration on the Knowles Head Peninsula.

### **Fish**

1. ***Has sportfishing adversely affected coho salmon populations at Hell's Hole or other sites? What are the use and harvest levels?*** Refer to Chapter 4 and Chapter 5.
2. ***What are reasonable escapement goals for Hell's Hole and other heavily fished sites based on available habitat?*** Refer to Chapter 4 and Chapter 5.
3. ***Do commercial harvests and/or hatchery strays affect wild populations of pink, chum, or coho salmon?*** Refer to Chapter 4 and Chapter 5.
4. ***Are there any lingering effects to fish or habitat restoration needs from past logging activities?*** Refer to Chapter 4 and Chapter 5.
5. ***Are habitat enhancement projects needed to provide additional commercial, sport, or subsistence harvest?*** Refer to Chapter 4 and Chapter 5.



## **Vegetation**

1. *Could any Threatened, Endangered or Sensitive plant species occur in the area?* Refer to Conditions and Trends; Threatened, Endangered and Sensitive Plant Species.
2. *Are there any invasive plant species? Are exotic plant species being introduced by watercraft, aircraft, and shoes? Were any introduced in areas where timber was harvested and roads built? Any invasives documented to date?* Refer to conditions and trends; Invasive Plant Species under Vegetation.
3. *What is the impact of the 2007 black-headed budworm outbreak?* Refer to Chapter 4.

## **Wildlife**

1. *What is the distribution of wildlife species in the analysis area?* A comment was made that deer numbers appear to be increasing on the mainland. Commenter felt the Forest Service should evaluate the situation closely. Information needed, refer to Chapter 5.
2. *What are the Threatened, Endangered and Sensitive species in the analysis area and what is their status?* Refer to Chapter 2 and 5.
3. *Is there a conflict with bear viewing opportunities at Olsen Bay and the RNA designation?* Information to collect, refer to Chapter 5.
4. *Where is there potential marbled murrelet habitat? Could harvested lands be managed to promote suitable habitat in the future?* Need to identify potential habitat areas, refer to Chapter 5. Young-growth can be managed to promote formation of complex forest structure including trees with nest platforms.
5. *What are the long term management goals for subsistence harvest species in the area and can these goals meet an increased demand for harvest?* Refer to Chapter 5.
6. *What information and education programs can be implemented that will improve public general stewardship practices?* Refer to Chapter 5.
7. *What are the effects of increased human use on wildlife habitat and distribution in the analysis area?* A concern was raised about brown bear numbers in Jack Bay; that numbers may be on the decline due to ease of access from Valdez. Another concern was raised about potential disturbance to bears if portage constructed between Port Fidalgo and Port Gravina. Another thought that Beartrap Bay was taking a beating with regards to bear hunting. Potential projects identified in Chapter 5.
8. *What are the opportunities to improve wildlife habitat in young-growth stands?* A comment was raised that the Forest Service should consider thinning young stands to promote better wildlife habitat. Potential exists on Knowles Head, refer to Chapter 5.
9. *What is the current distribution of invasive invertebrate populations and are these populations increasing in numbers and distribution?* Identified as a potential project in Chapter 5.

## **Heritage Resources**

1. *Inventory, analysis, and public interpretation of heritage resources on National Forest System lands are part of the Forest's legal mandate.* The question is how to

meet this mandate with the funding available. Off-site interpretation is addressed in Chapter 5 in recommendations, as is the development of Stewardship Agreements with outfitter/guides.

2. ***There is concern that the tribes be consulted on all heritage resource questions and projects.*** In accordance with Section 101(d)(6)(B) of the NHPA, the Forest Service consults with any Indian tribe or Alaska Native corporation that attaches religious and cultural significance to properties in the area of potential effects for any undertaking. Refer to Chapter 5, Project Implementation Recommendations.

## ***Land Ownership and Administration***

1. ***Concerns were raised about potential trespass along easements crossing private land and on private land in general.*** The Forest Service has stepped up efforts to ensure that the public is better educated about land ownership patterns in the Sound and to the legal uses of easements through information, maps, and signs. Maps could be provided to inform public about public areas for shoreline camping. Hardened sites for kayak camps may be an option.
2. ***Is there potential for a borough to be formed that will incorporate this area?*** There may be potential, but the issue is outside the scope of this analysis.
3. ***What role can the Forest Service take in the Places of Refuge Project?*** Concern was raised that the Place of Refuge working group obtain sufficient input to avoid damage to valuable public resources in the event of a vessel-related spill. It was suggested that Forest Service have active role to identify priority habitat in consultation with Coast Guard and State Department of Natural Resources.

## ***Mining and Minerals Potential***

1. ***Are the lands open to mineral entry?*** All public domain lands are open to mineral entry under the 1872 Mining Law unless specifically closed. Areas with the EVOS Fee management prescription have subsurface estates that are privately held that may be developed. The 501(b)-2 Management Area of the Copper River Addition is not open to mineral entry but hardrock minerals could be made available by leasing. Refer to Chapter 2, Minerals section.
2. ***What is the potential for mineral development?*** The National Forest System lands in the analysis area open to mineral entry have varying potential for mineral development ranging from “not favorable” to “identified mineral resources, highly favorable for future mineral development”. Chugach Alaska Corporation believes there are possible high grade prospects worthy of investigating on their lands and lands where they have subsurface rights. There is a highly mineralized belt extending from Latouché Island northeasterly through Ellamar, Tatitlek, and Port Fidalgo to the Copper River. The Forest Service must allow reasonable access to mining claims. Metal prices are currently very high (2008) which has increased mineral exploration. See Chapters 2 and 4, mineral potential.
3. ***Is there a demand for sand and gravel from National Forest System lands?*** The anticipated need for sand and gravel is low due to the remote nature of the analysis

area. If sand and gravel were needed for future projects, it could probably be obtained from private lands since these parcels contain alluvial deposits.

## **Recreation, Easements, and Special Uses**

1. ***What is the public demand for recreation opportunities in the analysis area and how does it compare to capacity?*** This issue is being addressed by the on-going Prince William Sound Framework project the Forest is undertaking with coordination with Native Corporation and other landowners. Issues raised during previous projects led to the Forest Service deciding to determine the carrying capacity before issuing more commercial permits. A concern was raised that excessive and high impact commercial use is the single greatest threat to the recreation experience in east Prince William Sound and the natural landscapes present. Another concern was raised that there was no need for additional developed sites. It was felt there was enough development on private and State lands. Another felt that tourism was getting out of control. One felt that unregulated water based uses limit chances for solitude while impacting the marine environment in sometimes severe ways. Examples given were commercial seining fleet use of Gravina, Fidalgo and Sheep bays, and oil tanker anchorages by Knowles Head. See the recreation section in Chapters 4 and 5.
2. ***How can easements be maintained in light of reduced budgets?*** In other areas, the Forest Service is working with Native corporations to maintain easements through partnerships using Bureau of Indian Affairs (BIA) funds under the Indian Reservation Roads program. This might work in this analysis area as well. A concern was raised that no new easements should be constructed, but existing easements should be clearly marked and maintained to reduce trespass problems.
3. ***An issue raised is the permitting of float houses in Simpson and Sheep Bays by the State of Alaska.*** Currently, in order for the State to issue permits for outfitter/guides in intertidal areas, the permit holders must have upland owner permission.
4. ***Are mooring buoys necessary to protect eel grass beds in some anchorages?*** In the past the public has not wanted mooring buoys in every cove. The concept of developing safe, man-made anchorages in Prince William Sound has been a topic of discussion for decades. The Forest developed several anchorages in western Prince William Sound in the mid to late 1980's. Since many of the protected anchorages in eastern Prince William Sound are relatively shallow and have good holding bottoms, no anchorages have been developed by the Forest Service.
5. ***A concern was raised about use of conservation easement in Jack Bay and motorized winter use in an area closed to this activity.*** Trees had been cut in easement. Commenter felt Forest Service should monitor the area and inform public about accepted activities.
6. ***Is a portage between Fidalgo and Gravina viable?*** Some felt that it would be a viable option while others were concerned about impacts to bears, the safety of the portage due to swift water conditions in Gravina at times, and visual impacts. One person suggested a hardened camp site at either end with information about bears, tides, and river flows. An option may be to avoid the river and direct people into the slough.



7. ***What is the potential for heliskiing?*** CAC has had people express interest for their lands. The potential is present.
8. ***A concern was raised that Port Gravina, Port Fidalgo, and Jack Bay deserve special attention and protection.*** The Forest Plan sets management prescriptions for the area. Responder felt commercial uses should be kept to a minimum to help limit uses. Another person felt that management of Port Gravina and head of Fidalgo should be for non-commercial non-developed recreation use: no guided hunting, fishing, tour boats or similar activities.

## **Subsistence**

1. ***Potential issue may emerge concerning herring and herring spawn if commercial harvest closed as was proposed in Southeast Alaska to protect subsistence use.***
2. ***How much pressure can the populations of fresh water species sustain?*** Cordova and Tatitlek are rural and qualify for federal subsistence. Tatitlek currently has high use in marine waters. In the future there may be competition for fish from freshwater. Cutthroat and Dolly Varden species used.
3. ***A concern was raised that subsistence uses should be given a priority, Tatitlek in particular.*** Subsistence uses are given a priority.

## **Oil spills**

1. ***What are the lingering effects of the Exxon Valdez Oil Spill in the analysis area?*** Refer to Chapters 4 and 5.
2. ***What are the effects of diesel fuel spills in the analysis area?*** Refer to Chapters 4 and 5.



## Chapter 4 – Conditions and Trends

### ***Disturbance Regimes and Geomorphic Processes***

The disturbance regimes in the area include glacial and tectonic activity, wind, precipitation, insect and diseases, and erosion processes. Human caused disturbances include the *Exxon Valdez* Oil Spill, timber harvest, and limited disturbance from other human activity including recreation use.

### **Climate**

The climate throughout Alaska has gradually become warmer over the past century. Although average temperatures show natural climatic oscillations, the trends at climate stations in Cordova, Valdez, and on the Kenai Peninsula show gradually increasing average annual temperatures (Western Regional Climate Center, 2007).

### **Glacial and Tectonic**

Climatic changes have increased the rates of glacial recession throughout south-central Alaska. The glaciers in the Eastern Sound analysis area continue to recede and thin. As a result of glacial recession, glacial outburst floods such as those that occurred at Rude Lake, no longer occur. Although the Rude, Gravina, and Fidalgo Rivers are presently affected by glacial processes, over time as the glaciers continue to recede, these rivers will change. As glacial sediment loads decrease, stream banks will stabilize, stream patterns will adjust to the lower sediment loads, and turbidities will decrease. These changes will occur very slowly over the next century.

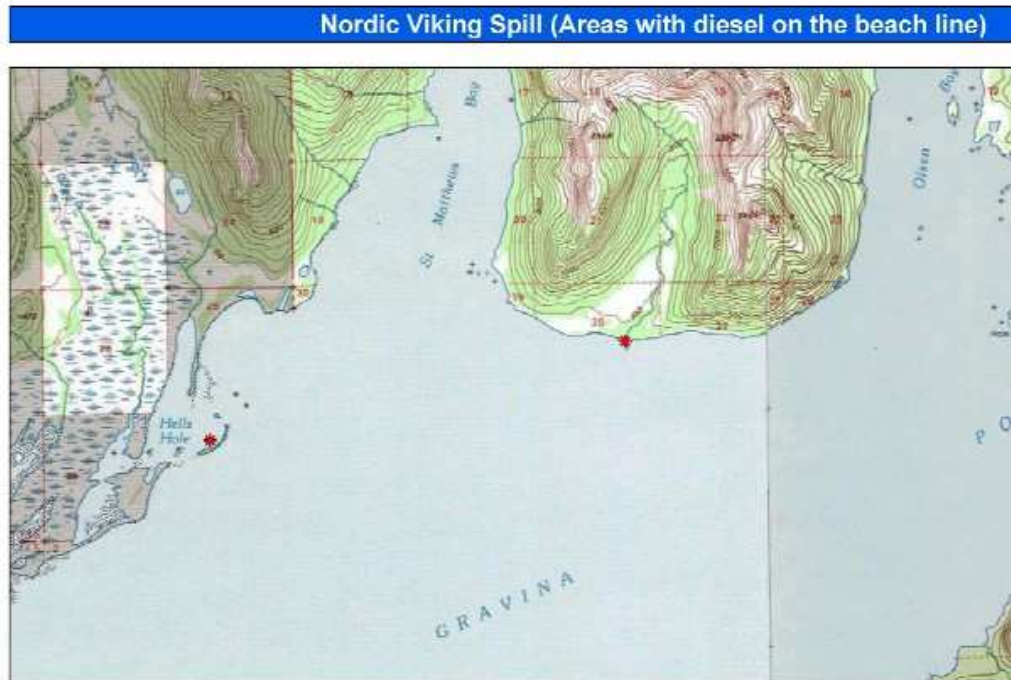
Tectonic uplift has occurred and will continue to occur throughout the region. Over the past 5,000 years, tectonic uplift has occurred regularly, with large events occurring on average every 600 years (Boggs 2000). Coastal streams will have to adjust to these changes in the base level, altering the channel morphology and in some cases affecting fish passage.

### **Effects of human uses on water resources**

**Oil transport through analysis area** - The Port of Valdez is the terminus of the 800 mile trans-Alaska pipeline where millions of gallons of crude oil is stored, loaded onto tankers, and shipped through Prince William Sound each year (<http://www.alyeska-pipe.com/pipelinefacts.html>). In March of 1989, 11 million gallons of oil was spilled into the Sound when the tanker *Exxon Valdez* struck Bligh Reef (Spies et al. 1996). This spill contaminated hundreds of miles of coastline in western Prince William Sound and was the largest spill ever in United States waters (Spies et al. 1996). The spill itself impacted and disrupted resources and human services in the Sound (USDA Forest Service 2007c). Although safeguards have been enacted to prevent future tanker spills, the possibility of another large spill is present.

On July 30, 2007 a spill occurred near Olsen Bay in Port Gravina. Approximately 3500 gallons of diesel fuel were spilled when the processor Nordic Viking ran aground on an island at the entrance of the bay (Fig.4.1) (ADEC 2007). The Alaska Department of Environmental Conservation (ADEC) determined that the marine waters of Port Gravina and the mouth of St.

Matthews Bay were affected (ADEC 2007). A residual sheen was observed on the shoreline at Hell's Hole and at the mouth of a small salmon stream east of St. Matthews Bay. Olsen Bay was not affected. The Shoreline Cleanup Assessment Technology (SCAT) team determined that the two impacted shoreline areas would be allowed to naturally remediate since a cleanup operation would cause more damage than the initial impact (ADEC 2007). ADEC will monitor the areas and Prince William Sound Regional Citizen's Advisory Committee (RCAC) plans to test mussels from the area. Sensitive resources include anadromous streams, marine mammals, and sea birds, especially oystercatchers and sea birds. No reports of injured wildlife were made (ADEC 2007).



**Figure 4.1 – Beach diesel spill areas from Nordic Viking, indicated by red dots.**

**Forest Management** - Forest management in the analysis area will have to consider the general hydrologic trends and effects on water resources. Most of the analysis area is relatively inaccessible backcountry. Areas that are most susceptible to impacts are along the coastlines. Human uses have impacted and will continue to impact streams in limited portions of the analysis area.

One of the most impacted areas within the analysis area is the Knowles Head Peninsula. Prior to this land being conveyed to the Forest Service in 1998, over 6,000 acres were clear-cut harvested and 91 miles of logging roads were constructed. Restoration of roads, landslides, and streams, and monitoring of the impacts of these uses on streams have been conducted since 1998.

The focus of these restoration activities has been to decrease sediment delivery from landslides to anadromous streams, decrease soil loss on hillslopes, and improve forest health and visual aesthetics. These goals are accomplished by activities such as seeding old landslide areas, stabilizing streambanks, and thinning regenerated areas. Past and proposed restoration

and monitoring of this area are described in the *Knowles Head Restoration Plan* (USDA Forest Service, Chugach National Forest, 2007).

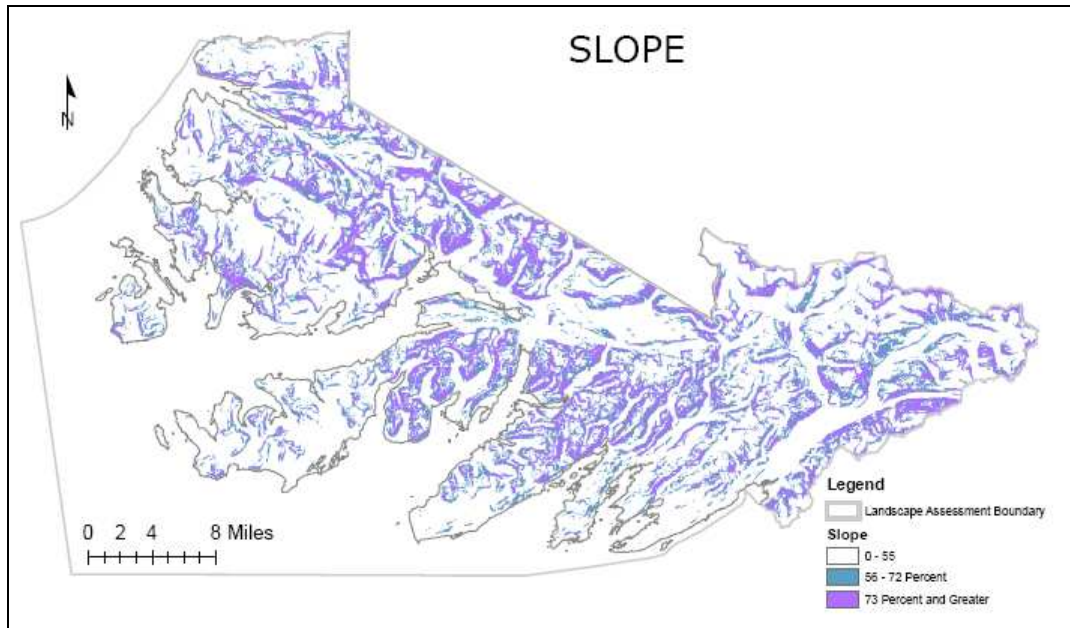
Current impacts of the disturbances at Knowles Head on sediment input into anadromous streams are limited. Erosion from the cut slopes of midslope roads and the sides of gullies have concentrated runoff and delivered sediment to streams, but adequate riparian buffers exist to moderate these effects. Revegetation in old clearcut areas has largely reduced sediment input into streams in these areas. Landslides, whether natural or caused by logging activities, have not directly impacted anadromous streams. However, future landslides from old roads and clearcut areas have the potential to impact streams.

**Recreation Use** - Human activities such as fishing, hunting, and hiking are relatively limited in this analysis area, especially with the large amount of area available. User trails and trampling of streambanks and human impacts to water quality are basically nonexistent in most of the area. Very few impacts from these uses have been observed at popular areas such as Hells Hole on the Knowles Head Peninsula (USDA Forest Service, 2007). However, the amount and severity of these impacts throughout the analysis area are not well known.

**Development** - A potential exists for increased resource damage in the future, affecting streams, stream banks, and water quality. Any type of development in the analysis area that results in high concentrations of people in an area has the potential to severely damage streams. Low gradient streams in the Floodplain and Palustrine process groups are particularly sensitive to bank damage, potentially resulting in increased rates of bank erosion, channel widening, and sedimentation. These impacts can also affect water quality and fish habitat.

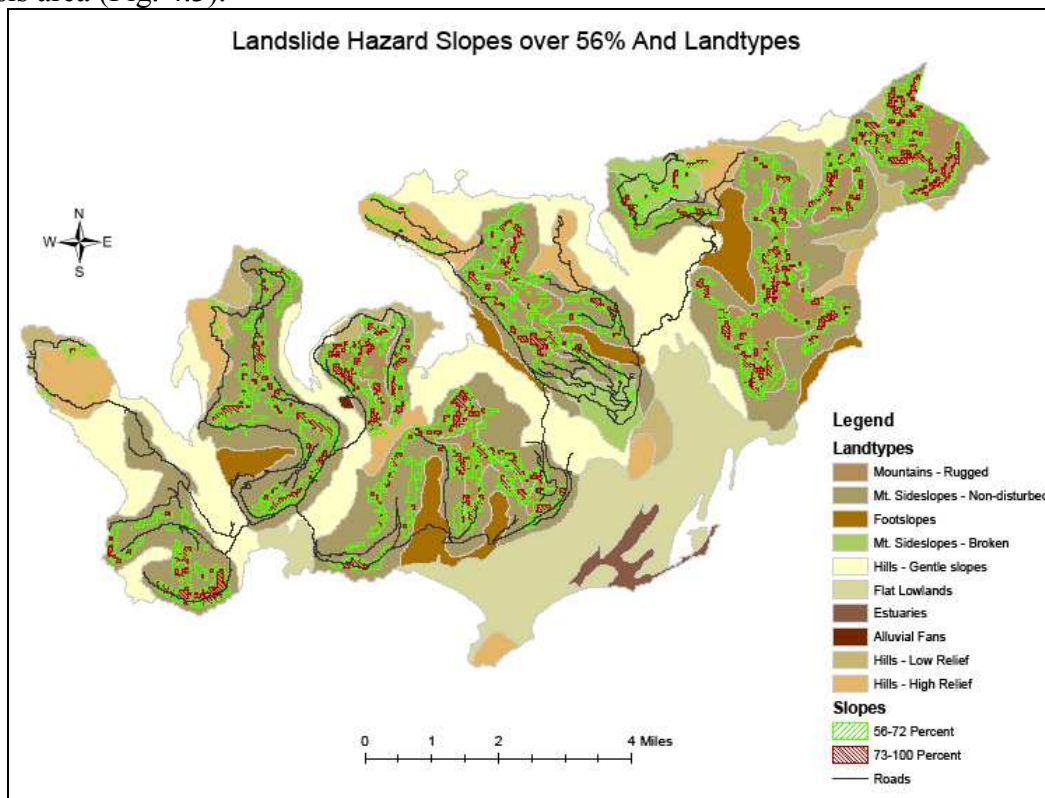
### **Hillslope erosion processes**

**Mass Wasting** - The potential for landslides on forested lands is dependent on several factors. Douglas N. Swanston (1997) developed a rating system for slope stability on the Tongass N.F., which factored in topographic attributes, soil properties, geology, and hydrologic conditions. Areas are evaluated based on their slope, topographic position, and any subsurface restrictions. These criteria are individually rated and the total score of a particular site can be used as an indication of its stability. This system was modified for use on the Chugach N.F. by Dean Davidson (Appendix B). Slope gradient tends to be the most critical factor. Landslides most frequently occur on slopes greater than 72% (Swanston 1997). On slopes between 72% and 56%, stability depends on other factors such as topographic position and restrictive layers. Slopes less than 56% are less likely to fail unless there are other critical limitations. Figure 4.2 displays the slope gradient of the analysis area. The Mountain Sideslopes unit is particularly susceptible to landslides based on these criteria. Many of the soils in these units are underlain by compact glacial till that can serve as a slippery surface if water is restricted and starts to flow just above it.



**Figure 4.2 – Slope gradient of analysis area.**

Overlaying the Mountain Sideslopes LTA on areas with slopes greater than 56% gives a preliminary overview of potentially unstable sites for the Knowles Head portion of the analysis area (Fig. 4.3).



**Figure 4.3 - Slopes greater than 56% in the Knowles Head portion of the analysis area.**

**Surface Soil Erosion** - Timber harvest and road construction in the Knowles Head portion of the landscape has produced direct and indirect long-term soil watershed effects. These include soil displacement, surface erosion, mass wasting (discussed above), and compaction. These processes are associated with both the harvest areas and the road system. Mass wasting appears to be a problem with the road system due to the excavation of cut-slopes and surcharge on the fill side. While erosion has or is occurring in the units that are above base-rates and affecting soil quality and watershed function, off-site soil and water effects are mostly associated with the road system. About 91 miles of roads are associated with the logging operations (Table 2.3). These roads comprise about 342 acres where soil quality and function would be degraded in the long-term unless obliteration and restoration occurs. Out of the approximately 33,037 acre Knowles Head area, about 6015 acres have been harvested.

### ***Conditions and Trends of Fisheries Resources***

Research indicates that management objectives at the landscape scale should stress the importance of maintaining a historical range of natural variability (Swanson et al. 1994, Kaufmann et al. 1994). The historic range of natural variability for fisheries resources is unknown for this analysis area; however, this analysis provides a recent, partial account by which to compare future fish population trends and habitat conditions.

#### **Population trends of the key fish species**

Fisheries resource conditions have been, and are still, controlled by the dynamic climatic and geologic activity such as earthquakes, uplift and subsidence, glacial lake outburst flooding, and climate change. Twelve thousand years ago there were no freshwater fish in the analysis area because it was covered under a thick layer of ice during the last major glacial period. Since then, fish have colonized the many streams and lakes produced by the receding glaciers.

The climate is important to fish mainly in the way it can affect winter habitat. Because of the mountains, much of the fall and winter precipitation falls as snow rather than rain. Thus, the runoff and stream flow is much lower during the winter months than in the watersheds where the average elevation is lower. Winter habitat for juvenile coho salmon and other species wintering in freshwater is reduced, and eggs in the gravels have a greater risk of being dewatered or frozen.

The climate and terrain can also combine to adversely affect juvenile fish rearing in the streams. MacFarlane (2005 USFS unpublished report) noted that the high precipitation and small high-gradient watersheds on Montague Island (50 miles southwest of the analysis area) often leads to high “flashy” flows in the stream systems. The same conditions can occur in the streams of this analysis area after heavy rain, rain on snow events, and during the spring snow melt. High flows can displace juvenile salmonids from their habitat (Bustard and Narver 1975, Nickelson et al. 1991) causing them to expend excessive energy or subjecting the fish to physical injury (Bustard and Narver 1975). Thus, in the streams without ample side channels, beaver ponds, or other low-velocity areas, juvenile coho salmon and other species can have low survival rates during these high water events. This may be another reason for the relatively low numbers of streams with coho salmon and small populations where they do occur.

The uplifting of the analysis area during the 1964 earthquake has affected pink and chum salmon spawning habitat in the intertidal and near-tidal zones of the freshwater streams, and, perhaps to a lesser degree, coho and sockeye salmon estuarine rearing area. The amount of uplift ranged from one foot around Jack Bay in the northwest to six feet at the Rude River in the southeast part of the analysis area (USDA Forest Service 1983).

The direct effect of the uplift was the death of eggs and alevins in the spawning gravels due to dewatering or substrate movement and egg dislodgement as the stream channels adjusted to the changes in gradient. Thorsteinson et al. (1971) estimated egg destruction in the spring of 1964 reduced the adult return of pink salmon by 225,000 over the entire Prince William Sound area. Continuing channel instability at Olsen Creek in Gravina Bay (uplifted four feet) led to the further loss of an estimated 7.8 million pink salmon eggs and 1.5 million chum salmon eggs and alevins from the 1965 spawning season (Thorsteinson et al. 1971).

Pink and chum salmon population data before the earthquake are limited, but the annual aerial escapement counts by ADFG after the earthquake do not show any catastrophic declines. The pink salmon escapement counts in the Eastern commercial fisheries district averaged roughly 539,000 from 1960 to 1964. From 1966 to 2005, the average escapement was 476,000. Chum salmon escapement averaged approximately 132,000 from 1960 to 1966 and 105,000 from 1967 to 2005 (Hollowell et al. 2007). Although the post-earthquake averages are somewhat lower, changes in ocean conditions or other factors could be responsible. Escapement counts for pink and chum salmon over the most recent 10 years are comparable to the pre-earthquake counts. Thus, there appears to be no indication of a lasting adverse effect.

The lack of effect may be because the habitat has stabilized. Thorsteinson et al. (1971) noted that only minor changes in the streambed occurred in 1968-1970 at Olsen Creek. Comparisons of aerial photographs from 1950, 1974, and 1993 of Olsen Creek, Rude River, Rogue Creek, and Simpson Creek show that the stream channels in the uplifted areas are generally less braided, narrower, and more heavily vegetated along the banks. Thus, it appears that these streams that had the greatest uplift (4-6 ft) have adjusted to the changes in gradient and the adverse effects caused by channel down-cutting and shifting should now be minimal. Normal channel shifting and meandering still occurs since these channels are all in depositional areas.

The other effect of the uplift has been to increase the amount of spawning habitat where channels in the intertidal zone were uplifted. Pink and chum salmon eggs can tolerate exposure to saltwater, but prolonged exposure is lethal. Thorsteinson et al. (1971) determined that the 4-ft tide level at Olsen Creek was the lower limit for successful intertidal spawning. After the area was uplifted four feet, the channel between the former 0- to 4-ft tide levels became available for spawning. Given the 0.5% gradient and 4-ft lift at Olsen Creek (Thorsteinson et al. 1971), an additional 800 linear feet of channel would be usable, not accounting for curves or multiple channels in the stream. By taking rough measurements on aerial photographs, it appears that Rogue Creek gained a bit less than 1/4 mile of channel, Simpson Creek about 3/8 of a mile, and the Rude River about 1/2 mile in several channels. Smaller systems that had not built up large low-gradient alluvial areas in the intertidal zones would have lesser increases in spawning habitat.



Rearing habitat for coho salmon, and to a lesser degree, sockeye salmon may have increased with the uplift as well. Juveniles of both species can rear in estuarine areas and tolerate varying degrees of salinity (Otto and McInerney 1970, Murphy et al. 1989). Areas too saline for rearing before the uplift should now have greater freshwater influence, providing additional habitat.

### **Biological Factors Influencing Fisheries**

**Beavers** - Beaver (*Castor canadensis*) ponds can provide important rearing habitat for juvenile coho and sockeye salmon (Murphy et al. 1989), especially for coho salmon winter habitat (Bryant 1984). Beaver ponds can be particularly important for watersheds that do not have lakes, sloughs, or other low-velocity habitat off the main stream channel. However, after examining aerial photographs of the East Prince William sound analysis area, there appear to be very few areas with beaver activity. Aerial photographs taken in 1990 show only two areas with identifiable beaver ponds: Rude River and an unnamed stream in Port Fidalgo. Aerial observations in 2007 indicated that considerable beaver activity occurs in the Rude River Valley, but the beavers may no longer be active in Port Fidalgo (K. Hodges, personal observations). An active beaver colony was reported in a creek at the western lobe of Two Moon Bay (Sloat, unpublished USFS report 2002). Beaver activity has also been observed at Hell's Hole (D. Lang personal communication), a small stream near Knowles Head, and at Comfort Creek in Port Gravina, but these sites do not appear to have had recent activity (D. Lang personal communication, K. Hodges personal observations).

One of the main reasons for the lack of beavers would be the relative scarcity of lowland areas. The lowlands have the low-gradient, low-velocity stream channels where beavers prefer to build their dams. The lowlands are also more likely to have Sitka alder and willow, which are used for dam building material and food. Thus, the broad, flat Rude River Valley has the best habitat for beavers, especially because its shifting channels encourage pioneer species such as alder and willow.

Not all lowlands are productive beaver habitat, however. The lowland areas around Hell's Hole have a high water table that restricts much of the alder and willow to the elevated berms directly adjacent to the stream channels. These drier berms are also the preferred habitat for Sitka spruce, so willow and alder are generally limited to the wetter margins. Thus, even in lowland areas, there is not always plentiful food or building material for beavers, and in turn, fewer ponds for coho salmon habitat.

### **Human Influences on the fisheries resources**

**Commercial Fishing** – The offshore waters of the analysis area lie within the Eastern District of the Prince William Sound Management Area for commercial fishing. The targeted species are pink and chum salmon. The Eastern District harvest data in the annual ADFG management reports are difficult to summarize because the pink salmon catch includes a large variable hatchery component and the chum salmon harvest in the Eastern District by itself is not available for the years prior to 1999.

For pink salmon, the wild stock harvest data are only available from 1999-2005 excluding 2002 (when only 335,000 presumed hatchery fish were harvested), the wild stock has

averaged 26.4% of the harvest and 3.7 million fish. During this period the total harvest has averaged 14.0 million, with the rest of the fish being almost entirely fish produced by the Solomon Gulch hatchery in Valdez.

The question that arises is whether the wild pink salmon stocks are being overexploited with this amount of harvest. The spawning escapement has averaged approximately 723,000 from 1999-2005 based on aerial surveys. It would appear that about 80% of the fish are caught, however, these surveys are only visual estimates made in the most productive streams. Fish in smaller streams and those hidden from view by vegetation or water conditions are not included. The actual escapement is probably much higher and the exploitation rate lower. ADFG manages the fishery not by the percentage of the fish caught, but by the numbers that “escape” the fishery and have a chance to reproduce. The generally consistent returns of pink salmon to the area over the years suggest that the numbers of uncaught fish are sufficient for a sustainable fishery.

The chum salmon harvested in the Eastern District are assumed to be almost entirely wild stock due to the distance to the nearest hatchery producing chum salmon (Wally Noerenberg hatchery, about 50 miles west of the Eastern District). There is some evidence of straying, however, which will be addressed under hatcheries. From 1999-2005, the chum salmon harvest averaged 123,000 fish. Chum salmon escapement averaged 165,000 fish, which gives an exploitation rate of about 37%. Again, the actual escapement could be higher due to the lack of counts in smaller streams and viewing conditions, which would reduce the exploitation rate. Escapement counts are relatively stable, and there is no indication that the stocks are being overexploited.

**Salmon farming and hatcheries** - There are five Pacific salmon hatcheries in the Prince William Sound area, producing pink, chum, sockeye, and coho salmon. Four of the hatcheries are operated by the Prince William Sound Aquaculture Corporation (PWSAC) and one by the Valdez Fisheries Development Association (VFDA). Most of the emphasis is on pink and chum salmon as indicated by the estimated numbers of returning adult salmon shown in Table 4.1; data are from McNair (2002), Farrington (2003, 2004), and White (2005, 2006, 2007). Almost all of the hatchery fish caught in the Eastern District are from the hatchery in Valdez.

None of the hatcheries are located in the analysis area, but the fish produced can affect the wild stocks through mixed stock harvest, competition, or straying into the streams and mixing with wild stocks. The effects could be considerable given the millions of fish the hatcheries produce. Hilborn and Eggers (2000) hypothesized that increased hatchery production simply replaced natural pink salmon production in Prince William Sound through harvest of mixed stocks and competition. They did suggest, however, that the Eastern District wild stock escapement may be less affected than other areas. Wertheimer et al. (2001) refuted the idea that natural populations were replaced, but the questions of competition and straying still remain.

<b>Table 4.1 - Estimated returns of hatchery produced adult salmon in Prince William Sound. Numbers are in millions of fish.</b>						
<b>Year</b>	<b>Pink PWSAC</b>	<b>Pink VFDA</b>	<b>Chum PWSAC</b>	<b>Coho PWSAC</b>	<b>Coho VFDA</b>	<b>Sockeye PWSAC</b>
2001	14.113	16.129	2.670	0.013	0.313	0.836
2002	14.998	5.265	6.323	0.028	0.099	0.955
2003	33.202	17.325	3.529	0.024	0.203	1.425
2004	10.696	11.140	1.955	0.015	0.144	0.654
2005	32.773	18.135	2.200	0.087	0.242	0.467
2006	12.190	9.061	2.230	0.178	0.295	1.036
<b>Ave.</b>	<b>19.660</b>	<b>12.851</b>	<b>3.151</b>	<b>0.058</b>	<b>0.216</b>	<b>0.896</b>

It is possible that pink salmon from the VFDA (Valdez) hatchery are straying into the streams of the analysis area, but no studies have been conducted in this region. Joyce and Evans (2000) found high percentages of hatchery fish in streams in the western and southwestern areas of Prince William Sound near PWSAC hatcheries and along the migration routes for hatchery fish. The streams selected for that study, however, were known to have high numbers of hatchery fish, so the stream selection was not random. There might also have been stream specific reasons for the high percentages of hatchery fish, such as little or no naturally occurring stocks (personal communication, Tim Joyce, 2007). Since the western part of the analysis area is along the pink salmon migration route to the VFDA hatchery, it is highly likely that strays are entering the streams in Galena Bay and Jack Bay.

The VFDA hatchery also produces coho salmon, and it is likely that some strays are entering streams along Valdez Arm and perhaps the Knowles Head Peninsula. No studies have been conducted to determine coho salmon straying.

Some hatchery fish were intentionally introduced into the area. Hatchery-raised coho salmon smolts were released in Boulder Bay near Tatitlek to provide a terminal harvest subsistence fishery for the local residents (Joyce, unpublished USFS report 2007). The report does not give a starting date, but 20,000 smolt were released annually until 2004, when the program was discontinued. No natural coho salmon runs exist in the immediate area, and with an average 5% ocean survival, the return would only be around 1,000 fish. Thus, it is unlikely that strays from these releases would affect wild stocks much. Strays from the 200,000 adult coho salmon returning to the Valdez hatchery would more likely have an effect.

Alaska Department of Fish and Game has conducted some limited sampling of chum salmon in the analysis area to check for hatchery straying. Hatchery fish were identified by the characteristic thermal marks on the otoliths collected from carcasses at the various locations (Merizon et. al. 2007). There have generally been low percentages of hatchery fish (Table 4.2), which is not surprising given the distance to the Wally Noerenberg hatchery or the Port Chalmers release site. It is surprising, however, that three hatchery chum salmon were found in the Rude River, which does not have a natural run and is the farthest stream from these sites. While the existence of straying cannot be denied, there is still uncertainty as to the effect these low numbers of strays can have on wild populations.

<b>Table 4.2- Hatchery chum salmon straying in the East Prince William Sound analysis area: percent of hatchery fish in number sampled (n) (Merizon et. al. 2007).</b>				
<b>Site</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>
Olsen Creek (Port Gravina)	2% (93)	2% (191)	0% (191)	0% (286)
Beartrap Creek (Port Gravina)		0% (373)	0% (192)	
Rude River	100% (3)			
Sunny River (Port Fidalgo)		28% (18)		
Port Fidalgo (stream not specified)				0% (285)
Indian Creek (Galena Bay)		3% (97)	5.5% (108)	2% (242)
Koppen Creek (Sheep Bay)		1% (226)	0% (97)	4% (24)

While the issue of hatchery straying presents biologists with many biological and ethical questions, the economic aspects of hatchery production are the primary concern for others. The VFDA hatchery provides a substantial contribution to the commercial and sport fisheries, and particularly to the businesses in Valdez that cater to anglers. It is unlikely that hatchery production would be scaled back significantly given the economic benefit. As long as hatchery pink and coho salmon return to Valdez, there will be some degree of straying and mixing with the wild stocks. ADFG manages the fisheries and oversees the hatcheries, so the Forest Service role in these matters should probably be limited to assisting ADFG with otolith collections or similar efforts.

**Sportfishing** – Sportfishing in the streams of the analysis area appears to be limited by the lack of roads, the use of boats in the off-shore waters, and the low number of streams with large runs of coho or sockeye salmon. Anglers prefer to catch the larger and more palatable coho and sockeye salmon, but if these are not available, some anglers will fish for the ubiquitous pink salmon, and occasionally, Dolly Varden or chum salmon. The sockeye salmon streams are in isolated areas and the populations are thought to be small, so there is probably limited, if any, fishing effort for this species.

Little sportfishing information is available specifically on the streams or the offshore bays in the analysis area. The information from the ADFG Sportfish division mail-in surveys is lumped into broad geographical categories that mix streams and saltwater areas from both within and outside of the analysis area. Thus, harvest and the effects of sportfishing in the analysis area can only be discussed in a general manner.

One ADFG set of data does give a rough indication of the level of use even though the area is not well defined. From 2003 to 2006, the East Prince William Sound shoreline harvest of coho salmon averaged 362 fish, and the pink salmon harvest averaged 100 (ADFG Sportfish Division, Sportfish Survey webpage). No harvest of other anadromous species was reported. Given that this low level of harvest could also include data from Hawkins and Hinchinbrook islands, shoreline harvest in the analysis area appears to be rather low.

The other saltwater and freshwater statistics are not useful because the higher harvest levels could mask a number of scenarios – high harvest outside the analysis area and low within, high within and low outside, or moderate harvest in both areas.

The Cordova Ranger District conducted angler surveys during the coho salmon season from 2004 to 2006. At the present time, the only data available for the analysis area is from 2005 at three locations. The numbers of coho salmon caught (including released fish) and harvested (kept) are as follows: Hell's Hole - 143 caught/40 kept, Sheep Bay - 111 caught/39 kept, and Simpson Bay - 237 caught/176 kept (unpublished USFS data).

Although these harvest numbers appear low for both the ADFG and Forest Service surveys, there can be a significant effect on the populations in small streams. In Simpson Bay, for example, the Milton Lake system is the only stream with coho salmon listed in the ADFG Anadromous Catalog. It is a relatively small system, with less than one mile of stream and 47 acres of lake. If all 176 coho salmon are being harvested from this system, there may not be enough spawning fish to lay enough eggs to fully use the available habitat and maximize production.



**Figure 4.4 – Hell's Hole sport fish site (looking southerly towards Port Gravina, (8/2007).**

Hell's Hole (Fig. 4.4) could also be affected by over-harvest. In 1999, eight or nine anglers were camped for about a week, and they kept their daily limits. In addition a Cordova business was transporting anglers to the area (personal communications with the anglers and observations 1999). Later that year, a Forest Service spawning survey of the West Fork of the Hell's Hole system found 103 spawners in a stream that had about 2900 ft<sup>2</sup> of spawning area (unpublished USFS data). This could be enough spawning habitat for about 250 to 500 fish. Thus, the stream appeared to be under-utilized by salmon.

The harvest that year may have been greater than usual, but there is no consistent data to determine this. If the 2005 Forest Service survey is somewhat accurate, and around 40 fish are being harvested, this would not affect the production of the system significantly, especially when the harvest is dispersed over the three forks of the Hell's Hole system.

Pink and chum salmon populations appear to be robust given the spawning escapement counts. Fishing pressure is assumed to be low, given that these species are generally not targeted. Thus, there are no concerns about the effects of sportfishing on these species.

No sportfishing information exists for Dolly Varden or cutthroat trout in the analysis area, although no harvests for these species were reported in the East Prince William Sound shoreline data mentioned previously. Again, these species are generally not targeted, although some people fish for cutthroat trout in the Milton Lakes system (Dick Groff, retired USFS, personal communication). The low bag limit for cutthroat trout (two fish per day) should protect their populations.

**Timber harvest and roading-** Timber harvest can affect fish and their habitat in a number of ways, but the logging roads cause the most problems. Roads can disrupt the normal surface flows, collect and concentrate water in the road ditches, and carry this water downhill to streams. This water is often laden with sediment from eroded cut banks, road surface erosion, landslides caused by the road, and disturbance at channels crossing sites. Fine sediment can clog interstitial spaces in streambed spawning gravels and reduce oxygen flow that is important for egg to fry survival (Chamberlin et al. 1991; Bjornn and Reiser 1991). Bridges and culverts can also constrict the stream channels and alter flows, causing erosion or blocking fish passage. Non-road effects include the loss of trees and other riparian vegetation where no streamside buffers are left, sediment input from disturbed soils, changes in stream temperatures, and changes in flow regimes.

The three main areas where timber harvest has occurred within the analysis area are: Eyak Corporation land in the Nelson Bay and Simpson Bay areas, Tatitlek Corporation land along the north shore of Port Fidalgo, and land on the Knowles Head Peninsula that was logged by the Tatitlek Corporation, but is now a part of the Chugach National Forest. The last of the logging was on the Eyak Corporation lands and was finished by 1998.

The effects of the logging at Knowles Head were fairly minimal even though a number of small restoration projects were needed. At most of the sites where culverts had been removed, the road fill was not completely taken out of the channel and sediments were sliding into the streams. Most of the restoration work consisted of removing the fill to decrease the bank angle and revegetating these areas to stabilize the slope (Fig 4.5). Other work included digging water bars to reduce flows on and along the roads and revegetating other disturbed areas.

Although all of the worst sites have been restored, road fill still needs to be removed at three road crossings and a few waterbars are needed (USDA Forest Service 2007b). Decisions need to be made as to whether several old log stringer bridges need removal, although the overlying fill has already been removed. Most of the roads now have naturally revegetated with alder, so erosion problems are expected to be minimal in the future. State-mandated 66-foot buffers were left along the fish-bearing streams, so riparian vegetation and stream temperature changes are not a major concern.

The effects of logging along Port Fidalgo are unknown but are probably minimal as well. The roads cross only six anadromous fish streams, so the extent of any effects to fish habitat would



be limited. Aerial photographs show that buffers were left along the streams in accordance with the State of Alaska standards. Clare Doig, land manager for the Tatitlek Corporation until the spring of 2008, said that all of the bridges and culverts had been removed at the stream crossings (personal communication 2007). If the road fill was not entirely removed as it was at Knowles Head, there is probably some erosion and sediment input to the streams. Depending on the amount of fill and whether it has revegetated, there may or may not be problems. The roads themselves have probably revegetated as they have at Knowles Head, so other road-associated erosion problems have probably lessened.



**Figure 4.5— Upper photo taken in 2004 of restoration work on stream crossing on Knowles Head road system. Lower photo was taken in 2005 of the same site.**

The Eyak Corporation logging roads in the Nelson Bay area were examined in 1999. Buffer strips had been maintained along the streams, but the bridges and culverts had not been removed. The crews surveyed 21 stream crossing sites. Of these, eight appear to be across fish-bearing streams. Five blocked culverts were found and erosion or channel head cutting were noted at six other crossings (Unpublished USFS data).

Erika Embey, environmental coordinator for the Native Village of Eyak, proposed surveying the roads and possibly removing culverts or conducting other restoration work, but no further action has occurred (personal communication 2007). Conditions on these corporation lands do not affect adjacent National Forest System land.

**Oil Spills** - In recent years two major oil spills have occurred in the waters adjacent to the analysis area. Since pink and chum salmon are intertidal spawners, they are particularly susceptible to the toxic hydrocarbons, as are other nearshore marine dwellers. In addition, the effects can continue long after the spill. Murphy et al. (1999) and Carls et al. (2004) found elevated levels of hydrocarbons in pink salmon spawning habitat four and ten years after the 1989 *Exxon Valdez* oil spill, respectively. Carls et al. (2004) inferred, however, that the contamination levels indicate that most habitats should have recovered or was recovering. Given the use of Valdez Arm as part of the transport route of crude oil from the Alaska pipeline, and the numerous fishing, commercial, and recreational vessels using the waters of analysis area, it is likely that other spills will occur in the future.

The *Exxon Valdez* Oil Spill occurred at Bligh Reef, just off the northwest coast of the analysis area. Due to prevailing currents, however, the 11 million gallons of crude oil were carried to the southwest. The only areas within the analysis area that were contaminated were some parts of Bligh Island. No major fish streams were oiled. It is possible that some light oil or hydrocarbons eventually drifted to other areas, but there is no evidence of significant impacts to fish streams or fish in the analysis area.

On July 23, 2007, a commercial fishing boat ran aground in Port Gravina near Olsen Bay, spilling an estimated 3,500 gallons of diesel fuel. Directly to the west, the tip of a peninsula with a pink salmon stream was contaminated. Diesel fuel was found in the substrate up to two feet deep (Jason Fode, USFS, personal communication). Pink salmon were spawning in the area. Farther to the west, fuel was washed up on shore at Hell's Hole, a popular coho salmon fishing area. The contamination there was relatively light, with fuel penetrating to a depth of a few inches. No fish were present (Jason Fode, USFS, personal communication). It is possible that the lighter, more volatile diesel fuel will not last as long or be as toxic as crude oil, but it is still likely that there was egg mortality in the pink salmon stream.

**Restoration and Enhancement Projects** - Several restoration and enhancement projects conducted by the Forest Service have been geared toward improving fish habitat in the area. As mentioned earlier, restoration work has been done at Knowles Head and these efforts are described in detail in the annual restoration reports (USDA Forest Service 1999 - 2007). The other projects are discussed below.



### *Control Creek Fish Ladder*

This fish ladder near Olsen Bay was built in 1973 to enable pink and chum salmon to ascend a 20-ft waterfall and access about a mile of spawning habitat upstream. The project was proposed when pink salmon prices were high and hatcheries had not yet begun to produce consistently large returns of fish. Since pink salmon have a consistent two-year life cycle, run strengths and genetic differences can develop separately in even- and odd-numbered years. It appears that odd-year fish have adapted to migrating upstream, with 3,000 - 10,000 fish ascending the ladder in odd years and fewer than 100 in even years. Only two or three chum salmon have ever been seen above the ladder.

While the ladder may have served its purpose when pink salmon were scarce and the price was high, its contribution to the commercial fishery is minimal at this time. There is no significant sport or subsistence use in this isolated area. It does enhance a small percentage of the wild stock escapement. It would be hard to justify building new fish ladders for the enhancement of pink or chum salmon under the current market or ecological conditions.

### *Plateau Creek, Comfort Creek Instream Habitat Structures*

A number of pool-forming log structures and cover structures were placed in Plateau Creek (1997) and Comfort Creek (1999) to enhance juvenile coho salmon rearing habitat. Twelve structures were placed in Plateau Creek (Hodges and Schmid 1999), and only two in Comfort Creek (unpublished USFS notes). These structures have not been monitored recently, but it is doubtful that they are still functioning. Monitoring of similar structures in other streams has shown a life expectancy of only four to five years, depending on stream conditions (personal observations). One problem was the lack of large trees for structure material and inexperience with structure design. In retrospect, the work in both systems should have focused on the creation of off-channel habitat or enhancement of habitat in the smaller tributaries.

## **Factors Affecting Vegetation**

### **Wind Influences**

Wind influences vegetation structure and composition to varying degrees depending on the extent and severity of the disturbance. Scattered windthrow commonly occurs along forest edges due to the high winds that frequent the area.

In the Knowles Head area where timber harvest took place, scattered blowdown continues to occur predominately along ridge tops and edges of the harvested areas (Fig 4.6). By August 1999, approximately 660 acres, or 7% of the remaining standing mature forest, had blown down. By August 2000, an additional 276 acres blew down, increasing the amount of mature forest that had blown down to 10%. About 39.5 of these acres were within 100 feet of the ocean shoreline. By August 2001, an additional 66 acres blew down, increasing the amount of mature forest that has blowdown down to 11%; about 8 acres were within 100 feet of the ocean shoreline. Scattered windthrow of standing trees occurred on 211 acres in areas that had experienced blowdown in the past. The blowdown observed in 2002 and 2003 was scattered pockets in areas with existing blowdown or extensions of those areas. In 2003, 462 acres of a mix of old and new blowdown was mapped. The stands continued to unravel along the edges of harvested areas. The Cordova District GIS geodatabase for the Knowles Head area contains

detailed information on blowdown. During the 2006 flight, no large areas of new blowdown were observed, but trees are continuing to blow down along the edges of the harvested areas.

Wind continues to play a role in shaping stand structure in the area. Orientation of the harvested areas accelerated windthrow on southeast facing slopes. Stands continue to unravel, but at a slower rate than previous years. To date, about 12% of the residual mature forest has been damaged by wind. Wind is a prevalent stand replacing disturbance event for Prince William Sound. Blowdown may have been minimized if the harvest pattern had been different, but it is unlikely any treatment now would have much effect. Small-scale wind damage can be expected to occur as stems snap on protected north slopes and leeward sides of mountains. Wind throw will also continue to occur along south facing slopes, ridge tops, and along east and west flanks of harvest units and play a role in developing stand structure. It may also increase potential for insects and disease in the area.



**Figure 4.6 – Area harvested on Knowles Head and associated windthrow. August 2007**

### **Timber harvest**

As described in existing conditions, approximately 8100 acres of mature conifer forests were harvested in the analysis area. No commercial harvest has occurred since 1998. The majority of the harvest occurred on Native corporation lands between 1989 and 1996 when 7600 acres were harvested. These harvested areas are regenerating to dense hemlock and spruce mixed conifer stands.

In the Knowles Head area, conifer regeneration of the harvested units are fully stocked with conifer regeneration and in most cases the number of trees is over 1000 stems per acre. However, side-cast and crib road failures on upper slopes may bury many acres of naturally regenerating trees and ground cover. Slash, debris, and log piles left at landings are decaying,

becoming unstable, and starting to ravel down steeper slopes. The road accessing the units along the south side of Knowles Head has piles of debris, slash, and logs about 15 to 20 feet deep and 20 to 30 feet wide along the majority of its length. This road is within a couple of hundred feet of the shore. The regeneration of this area will be delayed until this material decomposes and seedlings can become established. In some areas, a buffer only 2 to 3 trees wide was left along the shore and scattered blowdown is occurring.

### **Insects, disease, and animal damage**

Insects and diseases are two other disturbance regimes that can shape forest composition, structure, and development. Aerial surveys conducted by State and Private Forestry in 2001 identified a black-headed budworm (*Acleris gloverana* (Walsingham)) outbreak on 3526 acres in Port Gravina and Port Fidalgo. In 2002, a total of 32 acres were mapped in Port Fidalgo and Port Gravina. In 2005, approximately 1400 acres were mapped in the eastern portion of Prince William Sound. A small area on Knowles Head was coded as having an outbreak in the 2005 report, however it appears it is mapped where field surveys determined that porcupines had caused top kill of the spruce in the stands. No other outbreaks were recorded in the area until the summer of 2007 (Wittwer 2002, 2003, 2004, 2005; Snyder 2006, 2007). In 2007, a major black-headed budworm outbreak took place throughout Prince William Sound. According to a Pest Alert distributed by State and Private Forestry in August 2007, the exact extent of this intense infestation has yet to be determined, but the US Forest Service Forest Health Protection group is currently assessing the current distribution (Lundquist 2007). Effects include top-kill and reduced growth. If the population remains high and trees are defoliated for several years in a row, tree mortality can occur. Black-headed budworm has been reported several times in Prince William Sound during the past 35-40 years (Lundquist 2007). They have a long history in Alaska. Populations usually increase rapidly, persist for 2 to 4 years, and then decline rapidly (Lundquist 2007).

Porcupines appear to be playing a role in shaping stand structure. Porcupines have impacted the spruce in the area harvested in the 1960s quite heavily and as a result may swing the stand to a more hemlock dominated forest in the future.

### **Non-Native Plant Species**

Existing surveys on the Chugach National Forest (DeVelice et al. 1999; DeVelice 2003; Duffy 2003) indicate that most occurrences of non-native plants on the Forest are presently in areas of intensive human-caused disturbance such as road edges, visitor facilities, trails, and trailheads. Non-native plants are rare within natural communities on the Forest.

Systematic surveys of non-native invasive plants have not occurred within the Eastern Prince William Sound analysis area. In general, the frequency of occurrence of non-native plants in the area should be very low due to the general remoteness of the area and difficult access. A query of the Alaska Exotic and Invasive Plant Information Clearinghouse database (AKEPIC<sup>9</sup>) returned no documented occurrences of non-native plants within the area. It is likely that scattered populations of non-native plants are present, but the extent and number of individuals is likely small. However, the potential for introduction and spread of non-native invasive plants is of concern. Since early

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<sup>9</sup> <http://akweeds.uaa.alaska.edu/>

detection and treatment of invasive plant populations can effectively prevent spread, it is desirable to periodically search areas of high human use for non-native plants.

No non-native plants have been identified or located during the road and harvest unit surveys conducted in the Knowles Head area. Due to the harvest and roading activity in this area, the probability for invasives to occur would be higher in this area than other areas.

### Threatened, Endangered and Sensitive Plant Species

There are no known threatened or endangered plants within the analysis area. The only federally listed plant in Alaska is *Polystichum aleuticum*, which is listed as endangered. It is only known from Adak Island and is not expected to occur in the analysis area. The Regional Forester designated 19 vascular plants as sensitive in the Alaska Region. Of these, the following 12 species are known or suspected to occur on the Cordova Ranger District of the Chugach National Forest:

Eschscholtz's little nightmare ( <i>Aphragmus eschscholtzianus</i> )	known
Norberg arnica ( <i>Arnica lessingii</i> ssp. <i>norbergii</i> )	known
Moonwort fern ( <i>Botrychium tunux</i> )	suspected
Moonwort fern ( <i>Botrychium yaaxudakeit</i> )	suspected
Goose-grass sedge ( <i>Carex lenticularis</i> var. <i>dolia</i> )	known
Truncate quillwort ( <i>Isoetes truncata</i> )	suspected <sup>10</sup>
Calder lovage ( <i>Ligusticum calderi</i> )	suspected
Pale poppy ( <i>Papaver alboroseum</i> )	suspected
Smooth alkali grass ( <i>Puccinellia glabra</i> )	suspected
Kamchatka alkali grass ( <i>Puccinellia kamtschatica</i> )	suspected
Unalaska mist-maid ( <i>Romanzoffia unalaschcensis</i> )	known
Circumpolar starwort ( <i>Stellaria ruscifolia</i> ssp. <i>aleutica</i> )	suspected

Systematic surveys for rare and sensitive plants have not occurred within the analysis area. Presently, there are no documented occurrences of sensitive plants within the area. Based on comparison of a matrix of general habitats for the each of the species listed above (Stensvold 2006) and known habitats within the area, all 12 species potentially occur in the following habitats of the area:

- Aphragmus eschscholtzianus* - heath, alpine and subalpine habitats
- Arnica lessingii* ssp. *norbergii* - tall shrubland, open forests, meadows, alpine and subalpine habitats
- Botrychium tunux* - maritime beaches, upper beach meadows, well drained open areas
- Botrychium yaaxudakeit* - maritime beaches, upper beach meadows, well drained open areas
- Carex lenticularis* var. *dolia* - lake margins, marshy areas, alpine and subalpine habitats
- Isoetes truncata* - shallow freshwater
- Ligusticum calderi* - forest edges, wet meadows, alpine and subalpine habitats
- Papaver alboroseum* - well drained open areas, dry meadows, alpine & subalpine habitats
- Puccinellia glabra* - maritime beaches, upper beach meadows
- Puccinellia kamtschatica* - maritime beaches, upper beach meadows
- Romanzoffia unalaschcensis* - forest edges, streamsides/riverbanks, rock outcrops
- Stellaria ruscifolia* ssp. *aleutica* - lake margins, marshy areas, alpine & subalpine habitats

<sup>10</sup> There is one previously documented (but unverified) sighting of the sensitive plant, *Isoetes truncata* on the Cordova Ranger District. That occurrence is on the western portion of the Copper River Delta.

The potential number of sensitive plants to occur in a given area has been estimated using a bioenvironmental model that summarizes climatic, vegetation, and landform features to represent potential habitat. This model was developed during the Forest Plan revision process (USDA Forest Service 2002a). Based on this model, the areas with highest potential for the most sensitive plant species are the lower elevations in the analysis area (Fig. 4.7). The coastal fringe portion is the area of highest concern because it is also where most human use occurs, which could potentially impact sensitive species and their habitats. In general lower elevation coastal areas would likely need more intensive sensitive plant biological evaluation work than higher elevations.

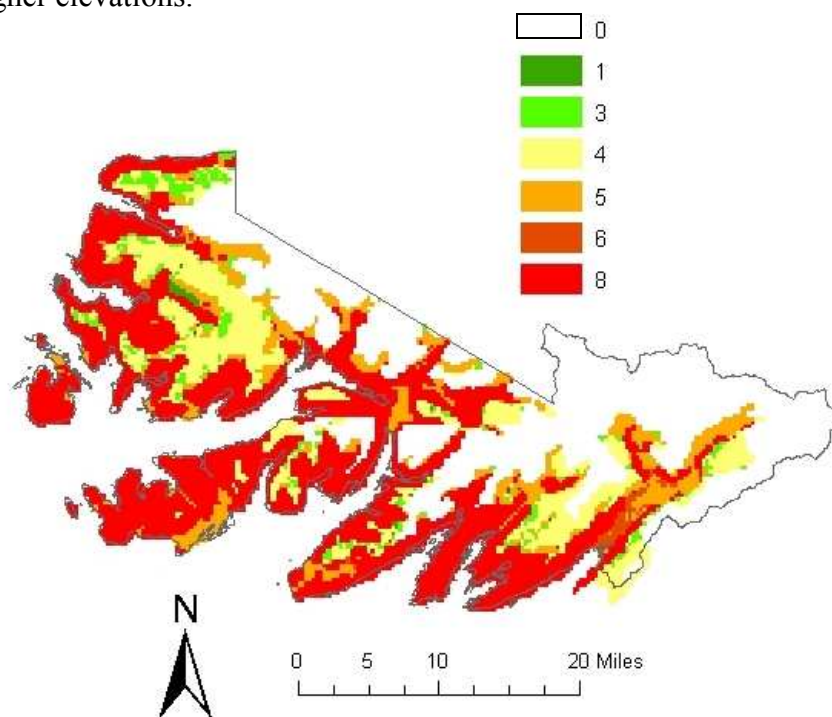


Figure 4.7 - Potential number of Alaska Region sensitive plant species in the analysis area. Red is highest with 8 species and white is lowest with 0 species.

### **Conditions and Trends of Wildlife Resources**

Large-scale natural processes (earthquake, uplift and subsidence etc) will continue to influence wildlife resources in the analysis area. Under the current Forest Plan, there is little reason to believe human related impacts will inhibit wildlife resources from expressing their full range of variability. Most of the analysis area will remain as a large, pristine and mostly roadless area. The area has a high degree of natural integrity with most long-term ecological processes intact (USDA Forest Service 2002c).

Oil transport through analysis area can have effects on wildlife resources. Seabird populations were directly affected by the *Exxon Valdez* Oil Spill, and collectively, have not recovered. Pigeon guillemots are considered to have not recovered, marbled murrelets are unknown, while common murre, common loon (*Gavia immer*), and cormorants are considered to be recovered. Not enough data exists to determine the effect of the spill on Kittlitz's murrelet

(EVOS Trustee Council 2002). The *Exxon Valdez* Oil Spill contaminated hundreds of miles of coastline in western Prince William Sound and was the largest spill ever in United States waters (Spies et al. 1996). The spill itself impacted and disrupted resources and human services in the Sound (USDA Forest Service 2007c). Although safeguards have been enacted to prevent future tanker spills, the possibility of another large spill is present.

In July 2007, a smaller spill occurred near Olsen Bay in Port Gravina. Approximately 3500 gallons of diesel fuel were spilled when a processor ran aground on an island at the entrance of the bay. Potential effects include high tide line vegetation and birds, especially black oystercatchers.

Increased use of the analysis area by people both guided and unguided sea-kayaking, camping, fishing, hunting, hiking, and motor-boating is likely in the future and impacts of these human uses will need to be monitored and mitigated if necessary. The Whittier tunnel, the fast daily ferry to Cordova, and increasing ecotourism in general will likely bring more people to the East Prince William Sound area.

The primary wildlife habitat enhancement opportunities for the Knowles Head area are related to creating old-growth habitat characteristics by thinning young stands to facilitate formation of a complex forest structure. The Forest Service Pacific Northwest Research Station recently published a pamphlet “Promoting Habitat Complexity in Second Growth Forests” (Carey 2003). It describes the benefits of variable density thinning which include helping generate complex forest structure by promoting tree growth at different rates, encouraging understory development, improving forest health by increasing resistance to disturbance, and improving the ability of the stand to recover after disturbance. Biological diversity is increased which allows ecosystems to function well through climatic variation (Carey 2003). It also describes cavity tree creation, coarse woody debris augmentation, conservation of biological legacies, extended harvest rotations, key structuring processes, and processes influencing species composition.

### ***Condition and Trends of Heritage Resources***

Heritage resources have been increasingly protected over the past 50 years as non-renewable resources. The National Historic Preservation Act of 1966 (NHPA) requires the identification and preservation of significant historic and prehistoric sites on federal land, and the mitigation of both direct and indirect impacts of federal undertakings on sites that are eligible for the National Register of Historic Places (NRHP). Of the known cultural resources in the analysis area, only a few have been documented and evaluated for the NRHP. The remaining either need to be documented and evaluated, or need to have determinations of eligibility completed. Increased recreation tourism, and use from the residents of Cordova, Tatitlek, and Valdez and other places can result in direct, indirect and cumulative impacts to cultural resources.

Prior to the exploration and subsequent development and the spread of introduced Western European diseases, historic properties consisted of Native Alaskan residences and camps primarily in areas near biological and botanical subsistence resources, with defensive qualities related to pre-European technology. With the advent of prospectors and miners in the late 1800s, and oil drillers in the early 1900s, historic properties illustrating human use of the

land began to be associated with mineral resource occurrences. The establishment of mining/drilling camps in the early 1900s created a need for employees who would live in their vicinity, and so contributed to changes in settlement patterns from those in late prehistoric and early historic times.

Under the Programmatic Agreement between USDA Region 10, the State Historic Preservation Officer, and the Advisory Council on Historic Preservation, the high sensitivity zones for cultural resources are identified using a predictive model that describes areas where proposed development may have an impact on heritage resources. These areas include:

- River valleys, lake and river systems providing passes or portages across larger land masses;
- All areas between mean high water and 150 ft. in elevation above mean high water, regardless of slope angle;
- Areas of former lode and placer mining activity;
- Elevated/fossil marine, river, and lake terrace systems; Lake and stream systems containing or known to have contained, anadromous fish runs, including barrier falls locations;
- Caves, rock shelters, and igneous rock formations known for caves and rock shelters;
- Known sources of potential raw materials;
- Other areas identified through literature or oral history research/sources.

Management of cultural resources is legislated by Acts of Congress and Executive Orders, which mandate inventories of cultural resources, and preservation and interpretation of all types of cultural resources for the benefit of the public for all federally funded undertakings. The NHPA requires consultation with Native tribes. In this area, that includes the Native Villages of Eyak and Tatitlek and Chugach Alaska Corporation. In areas selected for land conveyance by Chugach Alaska Corporation, the corporation will also be consulted as an interested party and as the Regional Native Corporation cultural representative. Other federally recognized tribes within the South central region may also be consulted with on a project by project basis. Other local interested parties may include groups such as the Cordova Historic Society.

Although the management prescription for the area calls for minimal development, the NHPA nevertheless requires that properties in the area which “may be eligible for the National Register are managed and maintained in a way that considers the preservation of their historic, archaeological, architectural, and cultural values in compliance with section 106 of this Act and gives special consideration to the preservation of such values in the case of properties designated as having National significance” (16U.S.C. 470-2(a)(2)(B)). Historic properties could not simply be neglected, because “Neglect of a property that causes deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe” is considered an adverse effect (CRF36 Part 800.5(2)(vi)).



## ***Conditions and Trends of Recreation Resources***

Recreation use in Prince William Sound by residents of Cordova and visitors alike has a long history. Cordova's tourism industry is growing at an estimated rate of 3 to 7% annually (Christensen and Mastrantonio 1999). Within the past 7 years a 35 bed lodge has opened as well as several bed & breakfasts and two rental car companies. With the advent of the daily high speed ferry connecting Cordova to Whittier and Valdez, Cordova's visitation rates have matched and in some cases exceeded the previous highs set during the Norwegian Cruise ship era based on Cordova Museum attendance records. Although most use is concentrated along the road system, an increase in the number of recreating public (commercial and non-commercial) in the eastern Prince William Sound analysis area is increasingly evident. Visitors currently enjoy activities such as fishing, hunting, hiking, camping, bird watching, mountaineering, river rafting, sightseeing, and guided hiking. In 2006, 67,000 non-Alaska residents visited Valdez according to the *Valdez Gap/Market Analysis, Vol. III Economic Baseline and Opportunities Analysis* prepared by the McDowell Group, Inc. Of these, 20% used the State Ferry and 24% take day cruises. Wildlife viewing is a popular activity as is sportfishing and nature walks and hikes.

Thirty years ago use in the area centered on commercial big-game guiding and sport hunting (goat, brown bear, and black bear). Today, not only do we have an increase in big-game guiding we also have request for special use permits for guided sea kayak tours, commercial sport fishing, float houses, heliskiing, cruise ship shore excursions, and lodges. The District is currently determining the carrying capacity based on the revised Forest Plan direction and the forth coming Prince William Sound Framework Decision.

Recreation activities that show the most use and highest increase are sport fishing and hunting. The majority of the occupants of commercial lodges and float houses are engaged in sport fishing activities. The time period with the most use and the potential to exceed capacity limits is the coho salmon season of August thru early September. The majority of sport hunting activities is associated with permitted big-game guides, but limited deer hunting via licensed transporters has occurred. Kayak-based camping in eastern Prince William Sound does not have the same issues as it does in the western Sound in terms of overcrowding and site degradation due to the lower use. The visitor use surveys conducted during the summer of 2007 identified shoreline camp sites but no visitor contacts were made. Many sites contained trash and amenities inconsistent with kayak based camping.

The analysis area does offer several opportunities for viewing wildlife. Currently, there are no designated sites or special use permits (SUP) that focus on viewing wildlife as a primary purpose. Although the present demand is low it is logical to assume it will expand in the future. The major issue will be how to manage two conflicting activities, guided big game hunting (consumptive) and watching wildlife (non-consumptive); both are dependent on the same resource.

Recreation and tourism services in the Sound are not considered to have fully recovered from the Oil Spill. Recovery of this resource must be done in a sustainable manner such that other resources recovering from the Spill are not adversely impacted. One poorly understood aspect of recreation and tourism in Prince William Sound is commercial recreation on upland areas

managed by the Chugach National Forest. Recovery of the recreation and tourism services is an important component in the overall recovery from the Spill. Understanding where, when, how much, and how often commercial activities occur on forest lands in the Sound is critical for managing the resources with a focus on the scope of commercial use of the area (USDA Forest Service 2007c).

Human use hotspots are important areas in the Sound where human use is concentrated. In many cases these locations are physiographic bottlenecks restricting access to desirable upland opportunities for recreation or subsistence activities. They exist in areas of concentrated seasonal resources such as the mouths of salmon streams or exceptional wildlife viewing opportunities. It is critical for the sustainable management of tourism, subsistence, and resources in the Sound that the location, timing and nature of these areas be well understood by National Forest managers. It is critical in order to ensure our management actions continue to enhance the experience of all users and provide for the restoration of the vital recreation/tourism and subsistence services while providing for the protection and restoration of EVOS injured resources (USDA Forest Service 2007c).

### **Trails**

Currently, the analysis area has very few developed trails and no new trails are planned. There are five trail easements that provide public access through privately owned lands to National Forest System lands.



**Figure 4.8 – Looking up potential portage route on slough of Gravina River (8/2007).**

A possible trail route/portage between Port Fidalgo and Port Gravina for kayakers has been identified as a potential trail construction project (Fig 4.8). It had not been pursued lately, however the idea surfaced again during scoping. Some folks think it would be a good idea, especially with the increased kayaking use in Prince William Sound. Others are not in favor of the idea due to the number of bears in the area, the fluctuating flow of Gravina River, and currents present during low tide in a narrow portion of Port Fidalgo. An option would be to post warnings about bears, the tides, and Gravina River and to locate the portage trail so that it

directs people to the tidewater slough on the north side of Gravina River instead of the main river channel.

If use patterns change and the demand for access into the backcountry of this analysis area increases, the District would re-prioritize its trail maintenance and development program.

### **Cabins and campsites**

Only one public recreation cabin and one administrative cabin exist within the analysis area. The Forest Plan calls for three new cabins to be built somewhere in Prince William Sound between 2005 and 2012 and reconstruction/rehabilitation of five additional cabins in that same period to reduce the backlog of deferred maintenance. However, through the Facility Master Plan process, constructing new recreation facilities will require very strong justification and possibly the removal of an existing facility in order to reduce the deferred maintenance backlog. To date, no new cabin sites have been identified within the analysis area.

Other than the five site easements associated with the five trail easements the District has not identified or developed any camping sites within the analysis area. The site easements are intended to be used only as staging areas for visitors using the trail easements to access public lands. No other overnight uses are permitted at these sites.

If kayaking activities were to increase in eastern Prince William Sound, the need to identify and develop hardened camp sites along the shoreline would become a higher priority.

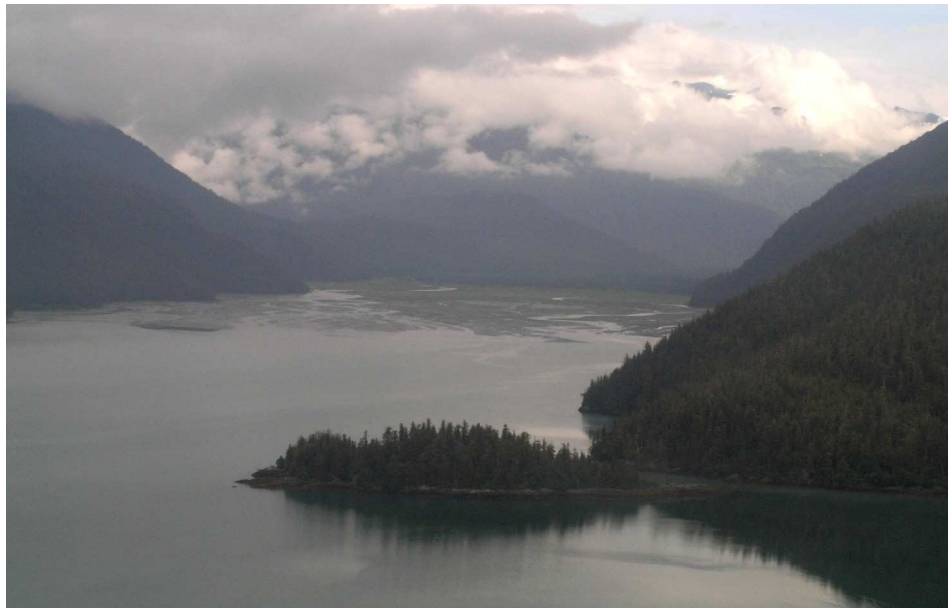
### **Motorized and non-motorized opportunities**

The Forest Plan identifies areas available to winter and summer motorized use. The majority of this analysis area is closed to summer and winter motorized use except for subsistence. One small area located at the headwaters of the Rude River is open to winter motorized use by helicopters and snowmachines and summer use by helicopters. Most of this area is covered by glaciers and snow (Fig. 1.3). Landowner permission to cross or use private lands is required.

This analysis area is classified Semi-Primitive Motorized and Semi-Primitive Non-Motorized and has very few Forest Service developments. The area has only a limited number of Class I easements trails; no other trails are present. Kayaking has been a growing activity in western Prince William Sound for the last thirty years. The eastern Sound has seen an increase in kayaking activity but not to the same extent. The eastern Sound lacks the travel routes with protected waters and numerous islands that typify the western waters. The enhancement and development of a known overland route connecting Port Gravina to Port Fidalgo would most probably enhance kayaking opportunities in eastern Prince William Sound.

Heliskiing is probably the fastest growing winter recreation activity on the Forest. The potential for premier/world class heliskiing in this analysis area is high. The demand in other areas on the Forest has been provided through the prospectus process which indicates that the list of interested providers is greater than available areas to conduct the activity. The two parcels at the upper reaches of the Rude River drainage are open for helicopter access. The remainder of this analysis area is closed to motorized use except for subsistence purposes.

Most of the analysis area will remain as a large pristine roadless area with high scenic value that provides the opportunity for recreation in a primitive and remote setting with plenty of solitude (USDA Forest Service 2002b).



**Figure 4.9 – Near the head of Port Gravina, August 2007.**

Increased visitation to the analysis area, hunting, fishing, camping, hiking, wildlife/scenery viewing, or other reasons is a certainty. Impacts of these human activities will need to be monitored and most likely mitigated. Activities with the highest potential to increase visitation and possible disturbance are shorelines in the summer.

### **Special Uses including outfitter guides**

The demand for special uses such as outfitter/guides, electronic sites, research, photography, and others is ever increasing. The demand by commercial operators for special use permits to provide outfitted and guided activities to the public in eastern Prince William Sound is high and growing every year. As the competition for use of National Forest System land increases so does the complexity of conducting environmental analyses and coordinating activities. Activities considered to be non-consumptive of resources are being processed depending on the type of service being offered and potential conflicts with existing users. Very few resource consumptive requests are being issued permits at this time.

Most of the eastern Prince William Sound analysis area is fairly remote and access is very limited. However, more individuals are developing plans to promote new guided or expand existing guided services. Whether this increased use spills over into the non-guided visitors remains to be seen. Recreational activities in this area have been rising and are expected to continue to rise. The introduction of the fast ferry to Cordova and Prince William Sound has definitely contributed to that increase. A determination of the capacity of the analysis area and the community to absorb and service this additional use has not yet been developed.

Linked with demand are concerns with human carrying capacities especially relative to the outfitter and guide industry. In recent years public scoping conducted for various special use permit applications or amendments to existing applications which considered increases in consumptive uses such as hunting or fishing has resulted in strong public response opposing additional uses. Crowding, reduction in quality of recreation experience, impact to the guiding industry, and reduction of viable fish and wildlife populations are the four most common concerns raised.

In the spring of 2006, due to the number of applications and request for special use permits in Prince William Sound, the Forest established the Prince William Sound Framework working group to address capacity issues and establish guidelines for issuing permits while at the same time maintaining quality recreation experiences. Several studies proposed by the working group were funded in 2007. It is expected that the Framework effort will be completed in 2009 and carrying capacity analysis for Prince William Sound completed by 2011.

Another on-going issue is the illegal, non-permitted use of National Forest System lands by a variety of outfitter/guides (heli-skiers, big game guides and fishing guides). By having a full-time law enforcement officer to the Cordova District, the ability of the Forest Service to prosecute violators has improved. The increased Forest Service presence can deter illegal operations from occurring.

### **Float Houses and Mooring Buoys**

Depending on the year, four or five commercial float houses have been moored in Simpson Bay, and 1 or 2 moored in Sheep Bay. They are in bays where the upland is privately owned. Some mooring buoys are adjacent to private lands but are not allowed adjacent to National Forest System lands as they are inconsistent with the upland management objectives as outlined by the Forest Plan. Of particular importance is EVOS acquired lands where the goal is to maintain the land in perpetuity for conservation and restoration purposes. Development activities are only allowed when necessary for conveying information to the public, to protect public safety, or natural resources, or for research or management of the area for “conservation or wilderness purposes”.

In other (non EVOS) areas these types of facilities may be in direct conflict with the upland management values for scenic integrity and may not meet recreation management objectives for the area. The back country prescription does not allow destination lodges. These facilities could impact public access, displace subsistence users and other recreationists, and increase competition for and impacts to fish, wildlife, and heritage (cultural and historic) resources.

### ***Potential for Mineral Resource Development***

The overall potential for mineral development to occur in the analysis area is highly variable across the analysis area. Nelson and Miller (2000) delineated the majority of the analysis area as “not favorable for future development of gold or copper resources”. A large linear area across the north edge of the analysis area was delineated as having “no identified mineral resources, but highly favorable [most favorable] for undiscovered resources” as was an area extending north of Galena Bay from the private lands between Port Fidalgo and Valdez Arm. An area between Port Gravina and Port Fidalgo was delineated that “contains identified

mineral resources, highly favorable [most favorable] for future mineral development”. The predominance of the areas described above as having moderate or high mineral potential are within the Backcountry Prescription which is open to mineral entry so the potential for development of mineral resources is existent although low due to the steep terrain and remoteness.

The potential for mineral materials or common variety mineral development on National Forest System lands is low due to the remote location of most of the analysis area. Development of these resources will depend on the need for roads and infrastructure and the lack of local private sources of the material.

All public domain lands are open to mineral entry under the 1872 Mining Law unless specifically closed. Bona fide mineral development cannot be prohibited where lands are open to mineral entry. On lands open to mineral entry, mining claims can be located and the mineral resources can be developed. The statutes also provide for a mining claimant’s rights to reasonable access for prospecting, locating mining claims, and developing the mineral resource. Such activities must conform to the rules and regulations of the Forest Service; however those rules and regulations may not be applied so as to prevent lawful mineral activities or cause undue hardship on bona fide prospectors and miners (FSM 2810). On lands closed to mineral entry, leasing or sales of mineral materials may still occur, but these sales are discretionary. The Forest Service may limit or prohibit such activities.

The BLM administers leasable minerals on National Forest System lands. The Forest Service may concur or consent to a lease, or withhold concurrence or consent. BLM regulations state that they will not lease over the Forest Service’s objections. If the Forest Service concurs or consents, they may also offer stipulations to be included in the lease agreement that are designed to protect or mitigate surface resource disturbance. Under the authority of the Act of March 4, 1917, prospecting permits and leases may be issued for hard-rock minerals in the Copper River ANILCA Addition which includes lands in the 501 (b)-2 prescription. These activities would be managed in accordance with Forest Plan direction which states that minerals activities are allowed consistent with the management intent, standards and guidelines.

Mineral development is often perceived as causing negative impacts to surface resources and conflicting with other uses of the land. It can be and is managed to minimize such impacts. Besides laws and regulations, the Forest Plan provides additional protection for wildlife and other resource values through standards and guidelines. In this analysis area, significant mineral development projects on National Forest fee and surface estate lands, private inholdings, or adjacent lands are possible however there has been little or no recent activity to indicate that mineral development is foreseeable. The remoteness of the area and lack of infrastructure would make any mineral development challenging and very costly.

The U.S. Geological Survey considers the area to have a high potential for as yet undiscovered mineral deposits. However, before mining could occur:

1. Prospecting and exploration must be first be done resulting in a discovery (mineralization must be of a character to encourage additional investment),

2. a newly discovered deposit would have to be evaluated and a feasibility study conducted (the outcome is a decision to abandon or proceed) ,
3. permits would have to be acquired (this can be a very long process complicated by appeals and lawsuits), and
4. infra-structure would have to be constructed (particularly expensive in remote areas).

This process generally takes years to complete, 20 years and longer is not uncommon.



## **Chapter 5 Recommendations for inventory, monitoring, and potential projects**

### ***Inventory and Monitoring***

We have very limited information about the resources of the East Prince William Sound analysis area. Baseline information for all resources would be beneficial to monitor the impacts of increased recreation in the area and changes triggered by natural events. The Forest Plan includes items to monitor in Chapter 5.

### **Soil Resources**

Except for the landslide inventories on Knowles Head, no other soil project-scale, catena-scale or watershed-scale soil quality monitoring has occurred in the analysis area. Once the Chugach NF soil monitoring protocols are completed, they should be used in the Knowles Head area. The results would then be evaluated against Forest Plan monitoring direction and the Forest Service Soil Quality Standards. Based on a review of the inventories noted and photos since 1996, forest roads would have to be obliterated and stabilized with deep-rooted vegetation before the surface erosion and landslide hazards are reduced to near pre-disturbance conditions. Geomorphic drainage in the subsoil and regolith could then ultimately be re-established and soil watershed function restored. The harvested units are restocked with trees and vegetation. Ground vegetation and ground cover mulch should be compared to undisturbed sites. If cover on or very near the ground surface is restored, then base rate erosion has been reestablished. Surface soil structure, density, pore space distribution, sorptivity, or some other measure of infiltration, aeration, and hydraulic conductivity should be done to indicate if the soil is back to pre-disturbance conditions from hydraulic and water storage and release perspective. If not, soil monitoring should be done intermittently to determine to what degree this major watershed process is functioning.

1. The analysis area lacks soil resource inventory of the FS National Hierarchical Framework of Ecological Units for the landtype phase and soil units. Other existing inventory units including landtypes do not meet Terrestrial Ecological Unit Inventory or National Cooperative Soil Survey standards.
2. It is recommended that monitoring occur at numerous sites on the Knowles Head Peninsula to determine the effectiveness of past restoration activities, identify additional areas that may need restoration, and monitor the occurrence and rehabilitation of landslides. These recommendations are described in detail in the *Knowles Head Restoration Plan* (USDA Forest Service 2007b).

### **Water Resources**

Because the Eastern Prince William Sound analysis area is primarily inaccessible backcountry and much of the area receives relatively little use, most of it is in its natural condition. The numerous changes over the past century will continue as the climate changes, glaciers recede, and uplift occurs. Human influences on water resources occurred throughout the Knowles Head Peninsula following logging activities between 1989 and 1996. Restoration efforts and natural regeneration have largely rehabilitated these areas. The current impacts of human uses

in the Eastern Sound area on streams, stream banks, and water quality are limited. However, the potential for greatly increased impacts to water resources exists if development or other circumstances occur that result in high concentrations of users near streams, particularly the low gradient floodplain and muskeg stream channels.

1. **Knowles Head restoration monitoring:** It is recommended that monitoring occur at numerous sites on the Knowles Head Peninsula to determine the effectiveness of past restoration activities, identify additional areas that may need restoration, and monitor the occurrence and rehabilitation of landslides. These recommendations are described in detail in the *Knowles Head Restoration Plan* (USDA Forest Service 2007b).
2. **Stream condition monitoring:** It is important to identify impacts of recreational human uses on streams before they become problems that require expensive restoration. It is recommended that the Chugach National Forest implement a simple monitoring plan to examine the condition of streams in areas where concentrated human uses are known to occur. This will provide information on the extent and distribution of these effects. Collection of physical stream characteristics as well as fish habitat and population data in undisturbed reference sites will be an important component of this monitoring in order to compare impacted streams to un-impacted streams of the same channel type.

## **Fish**

1. Monitor coho salmon sportfishing effort at Hell's Hole. Since the main season is less than a month long, a high percentage of the season could be monitored with ground or aerial surveys. Harvest information would require ground surveys. Monitoring trips could be combined with habitat data collection.
2. Conduct escapement counts at Hell's Hole. Assess estuarine area for juvenile coho salmon habitat (salinities, oxygen, juvenile use, available area). Assess available spawning area in the system. Use this information to determine the escapement goal and determine if the system is under utilized. Determine need for enhancement.
3. Analyze the habitat and escapement at Irish Creek to determine escapement goals.
4. Work with law enforcement officers to check harvest compliance at Hell's Hole, Irish Creek, and other areas that have high sportfish use.
5. Monitor instream structures at Plateau and Comfort creeks. If structures are not functioning, remove any cable or other unnatural material.
6. Do not implement hatchery salmon straying studies. ADFG is currently conducting studies on chum salmon straying, so unless some assistance is needed, there is no reason to duplicate any effort. As for pink and coho salmon straying, not only is it an issue that is under the jurisdiction of ADFG, but given the economic realities, it is unlikely that hatchery production will be reduced to the point where straying is no longer an issue.
7. Monitor Control Creek fishpass and maintain as needed.
8. Identify key rearing habitats for coho juveniles and habitat enhancement opportunities.
9. Identify presence and key habitat for cutthroat trout in the analysis area.
10. Provide support for inventory and monitoring needs for Olsen Bay Creek RNA (Refer to RNA establishment record).

## **Vegetation**

1. Document the spatial and temporal patterns of change in vegetation composition and structure to assess the extent of ecosystem change, the influence of management on these changes, and how the changes compare to the expected range (USDA Forest Service 2002c page 5-6).
2. Conduct a baseline survey for Threatened, Endangered, and Sensitive plant species, especially along the shoreline. The Prince William Sound Framework submitted an administrative study proposal to EVOS in 2007 to systematically survey potential habitat for rare plants across Prince William Sound. This would help us gain an understanding of rare plant presence and distribution across a range of potential habitats in order to facilitate development of recreation capacity allocations and recreation improvements to prevent damage to EVOS injured resources and services and to stimulate continued recovery of those resources and services (USDA Forest Service 2007c).
3. Conduct surveys to determine abundance and distribution of exotic plants, particularly in areas affected by management activities. Monitor selected sites to measure changes in exotic plant populations (USDA Forest Service 2002c page 5-8).
4. Identify infestations of exotic plant species and maintain infestation data in a standard database (Revised Forest Plan, page 3-4).
5. Coordinate with Forest Health Protection group to determine extent of impact of black-headed budworm outbreak, and identify potential treatment options, especially for young stands targeted for treatment to improve wildlife habitat.

## **Wildlife**

1. Identify presence and key habitats for breeding, feeding, shelter, and resting of wildlife species in the analysis area, with priority places on threatened and endangered species, species of special management concerns, and game species. Table 3-5 on page 3-28 of the Forest Plan describes important habitat sensitivity and seasonality for river otter, brown bear, Peale's Peregrine, Bald eagles, goshawks, and waterfowl. Desired surveys include those for land birds, small mammals, and winter track surveys for mid-sized carnivores.
2. Collect baseline data on timing of use by migratory species such as shorebirds and waterfowl. This would include spring and fall habitat use by water birds in Prince William Sound, winter goose surveys and goose nest distribution and abundance, and surveys to determine surfbird distribution and abundance
3. Document presence of amphibians and in particular, wood frogs, in the analysis area.
4. Develop studies to examine effects of human disturbance (on foot, by boat, or passes by airplanes, etc.) to brown bears at feeding sites. Monitor bear numbers and behavior at bear viewing areas.
5. Monitor motorized and nonmotorized access to determine if Forest Plan direction is influencing animal distribution and populations.
6. Document timing and use by brown bears at salmon feeding sites and important early season feeding habitats for bears.
7. Conduct goat harvest unit surveys to maintain a sustainable harvest of mountain goats for subsistence take.

8. Document locations of black oystercatcher nests. In 2007, the Prince William Sound Framework proposed an administrative study to EVOS to conduct shoreline surveys of the Sound and develop a database of all nesting areas to allow for more careful management of recreation in the Sound and protection of key black oystercatcher nesting sites. The database would serve as a benchmark to monitor effects of increased human activity (USDA Forest Service 2007c).
9. Inventory marine mammal habitat to determine areas with high probability of marine mammal disturbance.
10. Conduct surveys for invasive terrestrial species as European black slug, *Arion ater* L.

## Heritage Resources

1. Inventory cultural resources in project areas proposed by the Forest Service per section 106 of the NHPA.
2. Inventories of cultural resources on National Forest System lands outside identified project areas fall under Section 110 of the NHPA. These inventories could involve partnerships. The State of Alaska's Office of History and Archaeology staff has partnered with the Forest in the past and is a likely future partner for historic research, as are the departments of Anthropology and History of the University of Alaska. Depending on funding, two options to inventory the cultural resources of the area and develop a database are:
  - a. **Option 1 (High funding)** - Showcase Forest Service management of historic sites, complete the inventory and evaluation of cultural resources located within the high probability zones of the analysis area over a period of 11 years, and refine the predictive model after completing archaeological survey of 25% of those areas that are located within these high probability zones. The time necessary to complete a 25% sample is about three years. It is estimated that 30% of the analysis area is located within a high probability zone as defined by Regions 10's Programmatic Agreement. Although some of the districts, cultural landscapes, sites, buildings, structures, and objects in the analysis area have been documented to current national standards, less than 1% of the analysis area has been inventoried for cultural resources. A complete inventory will allow better interpretation of the significant historic resources in the analysis area related to Native Alaskans and early twentieth century mining. In addition to bringing the Forest into closer compliance with NHPA section 106, resources and their eligibility for the National Register will already be known for specific project areas.
  - b. **Option 2 (Moderate funding)**- Complete the inventory and evaluation of cultural resources located within the high probability zones of the analysis area over a period of 18 years and build a predictive model after 25% of this high probability zone is surveyed. The time necessary to complete a 25% sample is about 5 years. It is estimated that 30% of the analysis area is located within a high probability zone as defined by Regions 10's Programmatic Agreement. Inventory of cultural resources would continue in support of projects to satisfy the Section 106 requirements. Historic properties and cultural landscapes would be evaluated for the National Register for management purposes. Adverse affects to historic properties would be avoided. Interpret cultural resources only if necessary for

mitigation of adverse effects. Evaluate and maintain historic properties, rehabilitate if necessary for maintenance.

### Easements

1. Monitor conditions of easements and maintain on a 3-5 year rotation.

### Special Uses and Outfitter/guides

1. Monitoring special use permits primarily through field inspections and information received from the public.

### Potential Projects to Consider in the Analysis Area

Potential projects for this analysis area were listed in the revised Forest Plan, Appendix C. The IDT and public identified other potential projects for the analysis area. These projects would be further analyzed through the NEPA process and additional public involvement before a decision was made whether or not to implement the proposed project.

The Knowles Head Restoration Plan completed in 2007 also includes an integrated program of work for that portion of the East Prince William Sound analysis area. Refer to that document for a complete list of projects, monitoring, and maps. Before implementing a restoration proposal a full interdisciplinary team will design, review, and modify the proposal as necessary to fit the objectives of the restoration need. New information will be considered and incorporated. A soil scientist will design, modify, and review any restoration involving soil, including roads, slopes, and banks, a fisheries biologist will develop fisheries related restoration projects, and a silviculturist will develop prescriptions for treating vegetation.

**Table 5.1 - Potential Projects for PWS from Forest Plan Table C-2, page C10-11.**

Category	Activity	Year planned	Cost est.	Description
Trail construction	PWS trails	2008-11	\$900,000	Provide new trails to meet demand and prevent resource damage
Cabin construction	New cabins in PWS (not in this area)	2005 -12	\$350,000	Provide new cabins
Cabin reconstruction	Rehabilitate cabins in PWS	2004-12	\$300,000	Reduce backlog of deferred maintenance by reconstructing 5 cabins
Campsite Improvements	PWS campsites	2004-2012	\$700,000	Protect soil and vegetation in high use areas by providing hardened campsites
Fish habitat Inventory	Acquired lands Inventory	2002 (not completed yet)	\$20,000	Fish habitat inventory of streams on lands purchased fee simple

### Soil and water resources

1. Several sites on the Knowles Head Peninsula have been identified where bank stabilization and erosion control are needed at old road crossings and on old road surfaces. These recommendations are described in the *Knowles Head Restoration Plan* (USDA Forest Service, Chugach National Forest, 2007).

## **Fisheries**

1. Implement the projects listed in the Knowles Head restoration report (USDA Forest Service. 2007) to restore fish habitat affected by timber harvest operations. It is recommended that future instream work focus on enhancing rearing habitat for coho. Aside from this restoration work at Knowles Head (USDA Forest Service 2007b), no other areas on National Forest System lands have been identified as needing restoration work at this time.

At Hell's Hole, it is thought that the coho salmon stocks may have been over-harvested by sport-fishers in 1999, suggesting a need for enhancement. The 2005 sportfish survey results, however, showed relatively low harvest levels. Before any enhancement work is proposed, studies should be conducted to determine the actual need. Considerable habitat enhancement is needed to produce significant numbers of coho salmon. Thus, demand should be proven before projects are undertaken. Coho salmon harvest, habitat capability, and escapement numbers could establish whether the current harvest levels are sustainable. This could be applied to other streams where coho salmon are harvested.

Extensive surveys were conducted during the 1970s and 80s looking for potential enhancement opportunities, especially spawning channels and fish ladders (unpublished Forest Service data and reports). Aside from the Control Creek fish ladder, no other projects were found to be feasible.

2. Facilitate Olsen Bay Creek RNA inventory and research.

## **Vegetation - invasive plant species**

1. Treat infestations with a high potential to spread (Revised Forest Plan, page 3-4).
2. Take measures on exotic plants and animals to minimize their impacts on ecological processes (Revised Forest Plan, page 4-10, repeated on other pages).

## **Wildlife**

1. Develop a comprehensive database to manage human use in PWS relative to hot spots of activity.
2. Develop a habitat model for nesting black oystercatchers.
3. Migrate wildlife databases into NRIS fauna module and maintain the databases.
4. If located during surveys, control terrestrial invasive species as European black slug.
5. Develop and maintain GIS database on animal/habitat locations.
6. Install wildlife interpretive signs at key boat launch sites (Cordova and Valdez) and provide educational brochures about the analysis area to provide wildlife viewing and camping ethics and ecology information.
7. RNA inventory and research facilitation.
8. Determine spring and fall waterbird habitat use of Prince William Sound (why)
9. Thin young growth stands on Knowles Head to encourage winter browse species for deer and promote development of a complex forest structure for other wildlife species such as bald eagles, marbled murrelets, river otter, and harlequin ducks. Figure 5.1 illustrates where and when treatment would take place and Table 5.2 lists the amount

to thin each year. The Knowles Head restoration plan (USDA Forest Service 2007b) has detailed information about treatments including estimated costs. Planned activities have been entered into the National Forest Activity and Tracking System (FACTS) database.

<b>Table 5.2 – Potential thinning acres by year for Knowles Head</b>			
Year to Thin	Total Acres	# of Units	Harvest years
2014	79	1	1994
2015	37	6	1992-1993
2016	189	20	1992-1996
2017	129	5	1990-1991
2018	118	7	1992-1994
2019	273	15	1992-1994
2020	104	23	1994-1995
2022	24	4	1996

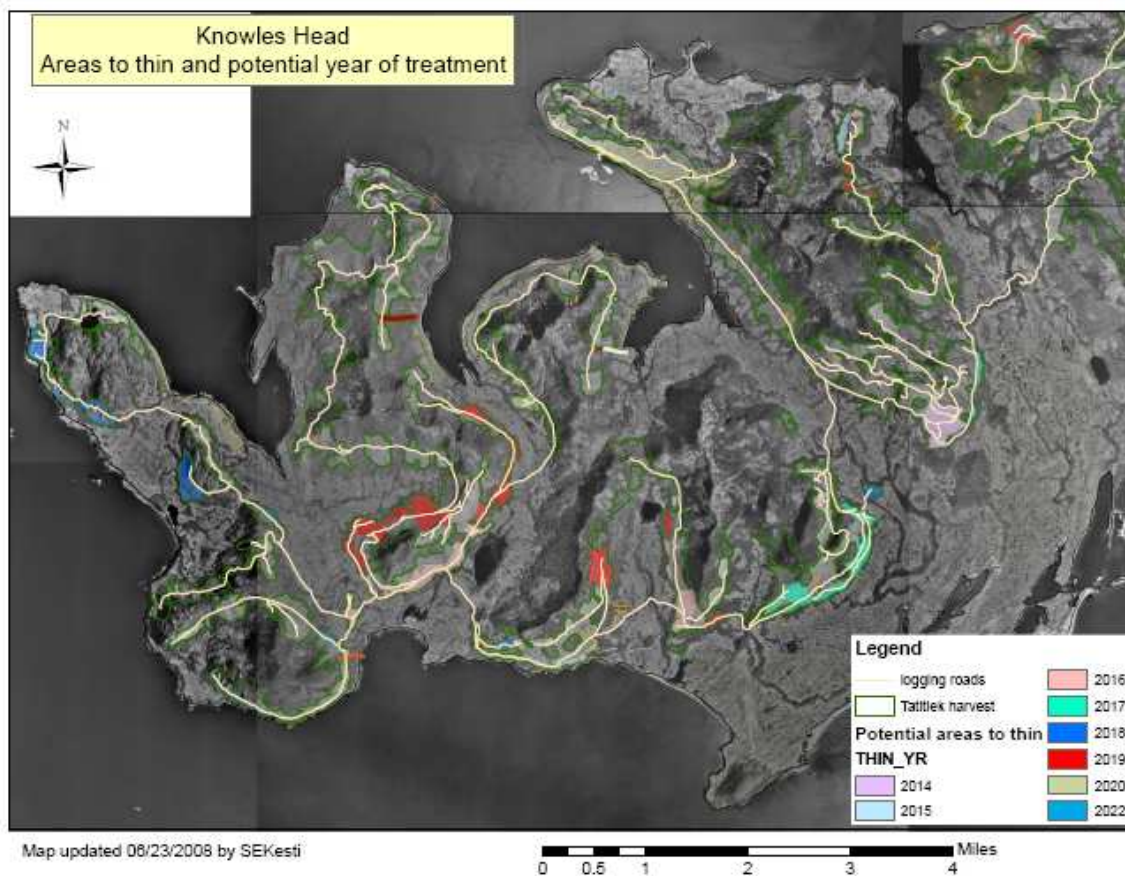


Figure 5.1 Potential thinning locations by year on Knowles Head Peninsula.

## Heritage Resources

1. Partner with interested entities for documentation, preservation, and interpretation of prehistoric and historic sites, cultural landscapes, and rehabilitation of historic buildings.



2. Develop collaborative stewardship relationships for protection and interpretation of cultural resources; partner with university programs for research work to provide background information for management and interpretation. Because of the rich history of use by indigenous peoples, followed by miners, fox farmers, and commercial fisher and processors, there are numerous potential partners for a variety of cultural resource related projects. Stewardship partners have been established for historic sites in western Prince William Sound on Glacier Ranger District and have proven to be successful in monitoring archaeological sites. Similar stewardship partners could be established in the analysis area. Potential partners include the Eyak and Tatitlek Native Villages. Other potential future partners in historic research and documentation are both the State of Alaska's Office of History and Archaeology and the departments of Anthropology and History at the University of Alaska. Two historical societies – Cordova, and Alaska, Historical Societies –have already demonstrated interest in partnering with the Chugach National Forest on documentation, preservation and interpretation of cultural resources on other parts of the District.
3. At the minimum, evaluate and maintain historic properties, but do not rehabilitate unless necessary for maintenance.
4. Develop stewardship partnerships with outfitter/guides to monitor sites.
5. Develop interactive website with Alaska Geographic and Ecotrust about Native peoples of Prince William Sound and traditional uses of animals and the area.

### **Research Natural Area**

The establishment record lists a few research opportunities within the area including:

1. Analysis of pink salmon genetic structure comparing early-run versus late-run, East Fork versus West Fork, and intertidal versus freshwater.
2. Documenting on-going changes to stream dynamics due to the 1964 Great Alaska Earthquake.
3. Quantifying the pattern and magnitude of salmon-derived nutrient transport from stream to upland systems (e.g., as described by Wilkinson et al. 2005).
4. Various watershed studies that could benefit from paired streams within a fully protected watershed.

### **Administration**

1. Maintain administrative use cabin at Olsen Bay for future project and research needs.

### **Recreation and outfitter guides**

1. Determine carrying capacity for guided and unguided publics using information generated from on-going Prince William Sound framework effort.
2. Develop kayak portage between head of Port Fidalgo over to Gravina River that flows into Port Gravina.
3. Determine if mooring buoys are necessary to protect eel grass beds. Map out eel grass beds in relation to popular anchorages.
4. Create an Access database of all recreation use to help manage the Special Use program and conduct the carrying capacity analysis.

### ***Exxon Valdez Oil Spill injured resources***

1. The Prince William Sound Framework (PWSF) proposed an Administrative Study to EVOS in 2007 to produce GIS layers for wildlife species, fish, and habitats as well as culturally sensitive areas affected by the Spill, specifically those still described as injured or recovering by the EVOS trustee council (USDA Forest Service 2007c).
2. A PWSF administrative study proposal included spatial and temporal characterization of PWS subsistence harvest activities. The data collected would be for 6 harvest activities: goat, bear, deer, salmon, marine mammal, and shellfish by harvesters in Chenega Bay, Tatitlek, Cordova, and Whittier through a partnership with ADFG Division of Subsistence (USDA Forest Service 2007c).
3. A PWSF administrative study proposal included compiling several existing data sources characterizing human use in Prince William Sound into a single comprehensive database. The human use hotspot GIS database and spatial analysis can ensure that management actions continue to enhance the experience of all PWS users and provide for the restoration of the vital recreation /tourism and subsistence services while providing for the protection and restoration of EVOS injured resources (USDA Forest Service 2007c).
4. A PWSF administrative study proposal included an analysis and spatiotemporal characterization of commercial activities permitted on National Forest System lands in PWS (USDA Forest Service 2007c).
5. A PWSF administrative study proposal included an evaluation of PWS user experience. To assess the recovery of the recreation /tourism services and more fully describe human use patterns and understand the potential for displacement resulting from competition between user groups and lingering oil and evaluate the existing management standards to determine if users are experiencing the qualities and attributes for which managers have planned (USDA Forest Service 2007c).

### ***Project Implementation Recommendations***

#### **Heritage Resources**

1. Manage cultural resources in conjunction with other resources. Human use of any area is generally due to the presence of various biological, botanical, geological, and hydrological resources. Managing and interpreting heritage resources simultaneously with other resources can provide a holistic view of the natural resources important to the people associated with the cultural resources of a site.
2. Consider indirect effects to cultural resources when designing and proposing projects. Indirect effects are those effects that may occur outside the direct footprint of a proposed project. An example is the creation of a new recreation trail which passes by a historic cabin or an archaeological site. By increasing the ease of access, and routing the public into the vicinity of the cultural resource, the integrity of the resource is put at risk of either purposeful vandalism or accidental disturbance by the public, and must be addressed by the project.
3. In accordance with Section 101(d)(6)(B) of the NHPA, the Forest Service consults with the Native Villages of Eyak and Tatitlek and the Chugach Alaska Corporation regarding projects in the analysis area. Consultation will be for the purpose of eliciting

views of Indian tribes on all aspects of the Section 106 compliance process during the earliest feasible steps of project planning. For new projects, this occurs initially through the quarterly Schedule of Proposed Actions, which is sent to each group approximately every three months, along with a letter requesting comments on any projects that are in areas with prehistoric or historic sites that are of religious and cultural significance. In addition, if projects will take place in the vicinity of known sites of Native cultural and religious significance, or within CAC 14(h)(1) selections, direct consultation regarding that particular project will occur.

### **Invasive Plant Species**

1. Incorporate exotic plant prevention and control into project planning and design (Revised Forest Plan, page 3-25).
2. Use the Chugach National Forest Invasive Plant Management Plan (USDA Forest Service 2005) as a guide to control or eradicate known non-native plant populations.
3. Treatment measures may be taken on exotic plants and animals to minimize their impacts on ecological processes (Revised Forest Plan, page 4-10, repeated on other pages).

### **Mineral Development**

1. It is recommended that if a request for a mineral material sale is received, to contract for disposal only if private resources are not readily available. Adequately demonstrating that private resources are not available would be the responsibility of the requester.
2. The Forest Plan does not address leasing of hard rock minerals on National Forest System lands. If an application for a prospecting permit [under the leasing authorities] is received, it is recommended that it be allowed if the activity can be accomplished consistent with the management area intent.
3. A lease should only be allowed following the issuance of a prospecting permit and upon sufficient evidence that a valuable mineral deposit likely exists. This evidence should be evaluated by a certified Minerals Examiner.

### **Threatened, Endangered and Sensitive Plant Species**

1. Because the analysis area is within the known or suspected range of sensitive plant species and contains potential habitat for sensitive plant species, plant biological evaluations to analyze the possible effects on these plants must be conducted for land disturbing project activities on National Forest System lands (FSM 2670.31 and 2670.32).
2. It is recommended that if any previously undiscovered sensitive plants are encountered prior to or during implementation of a project, the population should be protected and disturbing the area containing the population should be avoided (and similar habitats in that vicinity). The district or forest botanist/ecologist should be notified immediately to evaluate the population and recommend avoidance or mitigation measures.
3. Document sensitive plant population sizes and trends to determine their abundance and distribution and the effect of management on the species (USDA Forest Service 2002c page 5-8).

## References

- Alaska Department of Environmental Conservation (ADEC). 2007. Situation Report. Incident Name: F/V Nordic Viking Grounding. Contact: John Engles. ADEC. 2 pp.
- Alaska Department of Fish and Game (ADFG). 1999a. Mary Hicks ed. Federal Aid in Wildlife Restoration. Management Report, Survey- Inventory Activities 1 July – 30 June 1998; Brown Bear. ADFG. P. 55-72.
- ADFG. 1999b. Deer. Fed. Aid in Wildland Restoration Survey-Inventory Management Report, Survey-Inventory Activities, 1 July 1996 – 30 June 1998. Grants W-24-5 and W-27-1. Study 2.0. 98 pp.
- ADFG. 2001. Alaska wildlife harvest summary. ADFG web page (<http://www.state.ak.us/adfg/wildlife/geninfo/hunting/harvest.htm>) PDF document.
- ADFG. 2004. Alaska wildlife harvest summary. Alaska Dept. of Fish and Game web page (<http://www.state.ak.us/adfg/wildlife/geninfo/hunting/harvest.htm>) PDF document.
- ADFG. 2005. Brown bear management report of survey-inventory activities 1 July 2002- 30 June 2004. C. Brown, editor. Juneau, Alaska
- ADFG. Anadromous Fish Stream Viewer. [http://gis.sf.adfg.state.ak.us/AWC\\_IMS/viewer.htm](http://gis.sf.adfg.state.ak.us/AWC_IMS/viewer.htm). Downloaded November 2007.
- ADFG. Sportfish Division. Sportfish Survey webpage. <http://www.sf.adfg.state.ak.us/Statewide/ParticipationAndHarvest/index.cfm>. Downloaded November 2007.
- Alaska Heritage Resource Survey (AHRS). 2007. Alaska Heritage Resource Survey Database. Office of History and Archaeology, State of Alaska, Department of Natural Resources. Anchorage, Alaska.
- Alaska National Interest Lands Conservation Act (ANILCA). 1980. 16 U.S.C. 3101 et seq (1988), Dec. 2 1980, Stat. 2371, Pub. L. 96–487.
- Bartonek, J.C., J.G. King, and H.K. Nelson. 1971. Problems confronting migratory birds in Alaska. Pgs 345-361 in Transactions of the Thirty-sixth North American Wildlife and Natural Resources Conf. March 7-10, 1971. Wildlife Mgmt. Inst., Wash. D.C.
- Birket-Smith Kaj. 1953. The Chugach Eskimo. København, Nationalmuseets publikationsfond, Copenhagen, Denmark.
- Birket-Smith Kaj and Frederica de Laguna 1938. The Eyak Indians of the Copper River Delta, Alaska. København, Levin & Munksgaard, E. Munksgaard, Copenhagen Denmark.
- Bjornn, T.C. and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. *In* Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society Special Publication 19:83-138.
- Boggs, K. 2000. Classification of Community Types, Successional Sequences, and Landscapes of the Copper River Delta, Alaska. USDA Forest Service (FS), Pacific Northwest Research Station, General Technical Report PNW-GTR-469, March 2000.
- Bosakowski, T. and R. Speiser. 1994. Macro habitat selection by nesting northern goshawks: implications for managing eastern forests. *Stud. Avian Biol.* 16:46-49.
- Bowyer, R.T., J.W. Testa, and J.B. Faro. 1995. Habitat Selection and Home Ranges of River Otters in a Marine Environment: Effects of the *Exxon Valdez* Oil Spill. *Journal of Mammalogy*. Vol. 76 no. 1, p.1-11.

- Bright-Smith, D.J. and R.W. Mannan. 1994. Habitat use by breeding male northern goshawks in northern Arizona. *Stud. Avian Biol.* 16:58-65.
- Brown, L.A., G.B. Jennings, C.L. Scott and C.J. Utermohle. 2001. Alaska Community Profile Database version 3.12 7/10/2001 ADFG, Division of Subsistence.
- Bryant, M. D. 1984. The role of beaver dams as coho salmon habitat in southeast Alaska streams. *In* Proceedings, Olympic Wild Fish Conference, Peninsula College, Port Angeles, WA, Walton JM, Houston DB (eds). p.183-192.
- Burris, O.E. and D.E. McKnight. 1973. Game transplants in Alaska. ADFG. Game Tech. Bull. 4. 57 pp.
- Bustard, D.R. and D.W. Narver. 1975. Aspects of the winter ecology of juvenile coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Salmo gairdneri*). *Journal of the Fisheries Research Board of Canada.* 32:667-680.
- Campbell, B.H. 1990. Factors affecting the nesting success of dusky Canada geese (*Branta canadensis occidentalis*) on the Copper River Delta, Alaska. *Can. Field-Naturalist* 104(4):567-574.
- Carls, M., S. Rice, G. Marty, and D. Naydan. 2004. Pink salmon spawning habitat is recovering a decade after the *Exxon Valdez* oil spill. *Transactions of the American Fisheries Society* 133:834-844.
- Chadwick, D.H. 1973. Mountain goat ecology-logging relationships in the Bunker Creek drainage of Western Montana. Montana Dept. of Fish and Game Federal Aid Project W-120-R-3, and W-120-R-4; Final Report; Job BG-9.01.
- Chamberlin, T.W., R.D. Harr, and F.H. Everest. 1991. Timber harvesting, silviculture, and watershed processes. *In* Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society Special Publication 19:425-457.
- Christensen, H. C. and L. Mastrantonio, editors. 1999. Alaska's Copper River: Mankind in a changing world. USDA FS. PNW Research Station. Pp. 35
- Comely, J.E., M.B. Naughton, M.R. Hills, and K.M. Rafferty. 1988. Distribution of wintering dusky and cackling Canada geese in western Oregon and western Washington, 1985-1988. USDI FWS Report. 20pp.
- Courtright, A. M. 1968. Game harvests in Alaska. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Report. Juneau.
- Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. FWS/OBS-79/31. USDI FWS, Washington, D.C.
- Crocker-Bedford, D.C. 1993. A conservation strategy for the Queen Charlotte goshawk on the Tongass National Forest. USDA FS Report Final Rev. Draft (17 April 1992).
- Crone, L., P. Reed, and J. Schaefer. 2002. Social and economic assessment of the Chugach National Forest Area. USDA FS, Gen. Tech. Report PNW-GTR-561. 108 pp.
- Crowell, A.L., A.F. Steffian, and G.L. Pullar. 2001. Looking Both Ways: Heritage and Identity of the Alutiiq People. University of Alaska Press. Fairbanks, Alaska.
- Curran, J.H., D.F. Meyer, and G.D. Tasker. 2003. Estimating the magnitude and frequency of peak streamflows for ungauged sites on streams in Alaska and Conterminous basins in Canada. U.S. Geological Survey Water-Resources Investigations Report 03-4188, prepared in cooperation with the State of Alaska Department of Transportation and Public Facilities.

- Davidson, D.F. 1997. Ecological Hierarchy of the Chugach National Forest. Unpublished. USDA FS. Chugach National Forest. Anchorage, AK.
- Day, R.H., K.L. Oakley, and D. R. Barnard. 1983. Nest sites and eggs of Kittlitz's and marbled murrelets. *Condor* 85(3):265-273.
- Day, R.H. 1995. New information on Kittlitz's murrelet nests. *Condor* 97:271-273.
- Day, R.H. and D.A. Nigro. 1999. Status and Ecology of Kittlitz's Murrelet in Prince William Sound, 1996-1998. *Exxon Valdez Oil Spill Restoration Project Final Report* (Restoration Project 98142). ABR, Inc., Fairbanks, Alaska.
- Day, R.H., K. J. Kuletz, and D.A. Nigro. 1999. Kittlitz's murrelet (*Brachyramphus brevirostris*). In A. Poole and F. Gill, eds. *The Birds of North America*. Academy of Natural Sciences, Philadelphia, PA, and Am. Ornithologists Union, Washington, DC.
- de Laguna, Frederica. 1990. "Eyak" In *Northwest Coast*, Vol. 7, *Handbook of North American Indians*, pp. 189-202. Smithsonian Institution.
- DeVelice, R.L., C.J. Hubbard, K. Boggs, S. Boudreau, M. Potkin, T. Boucher, and C. Wertheim. 1999. Plant community types of the Chugach National Forest: southcentral Alaska. USDA Forest Service, Chugach National Forest, Alaska Region Technical Publication R10-TP-76. Anchorage, AK. 375 p.
- DeVelice, R.L. 2003. Non-native plant inventory: Kenai trails. USDA FS, Chugach National Forest, Alaska Region Technical Publication R10-TP-124. Anchorage, Alaska. 21 p.
- Duffy, M. 2003. Non-native plants of Chugach National Forest: a preliminary inventory. USDA Forest Service, Chugach NF, Alaska Region Tech. Pub. R10-TP-111. Anchorage, AK.
- Dumoulin, J.A. 1987. Sandstone composition of the Valdez and Orca Groups. Prince William Sound, Alaska: US Geological Survey Bulletin, 1774.
- Ebersole, J. and nine co-authors. 2006. Juvenile coho salmon growth and survival across stream network seasonal habitats. *Trans. of the Am. Fisheries Society* 135:1681-1697.
- Exxon Valdez Oil Spill Trustee Council (EVOS). 2002. Exxon Valdez Oil Spill Restoration Plan: Update on Injured Resources and Services, August 2002. 28 pp.
- Farrington, C. 2003. Alaska salmon enhancement program 2002 annual report. ADFG, Regional Information Report 5J03-05. Juneau, AK.
- Farrington, C. 2004. Alaska salmon enhancement program 2003 annual report. ADFG, Regional Information Report 5J04-02. Juneau, AK.
- Federal Geographic Data Committee. 2002. *Federal Standards for Delineation of Hydrologic Unit Boundaries, Proposal, Version 1.0*. March 2002, 52 pp.
- Fox, J.L., C.A. Smith and J.W. Schoen. 1989. Relation between mountain goats and their habitat in Southeastern Alaska. USDA FS, Pacific Northwest Research Station, General Technical Report PNW-GTR-246. Portland, OR. 25 pp.
- Frame, G.W. 1974. Black bear predation on salmon at Olsen Creek, Alaska. *Zeitschrift für Tierpsychologie* 35: 23-38.
- Greise, H. and E. Becker. 1988. Alaska deer hunter survey, Game Management Unit 6 final report. ADFG. Ann. Prog. Rep. Sitka black-tail deer survey and inventory activities, 1 July 1988- June 1988. Fed. Aid in Wildl. Rest. Rep. Juneau, AK.
- Griese, H. J. 1990. Unit 6 furbearer survey-inventory progress report. Pages 42-55 in S. O.Morgan, editor. Annual report of survey-inventory activities. Part XIV. Furbearers. Volume XX. ADFG. Federal Aid in Wildlife Restoration Progress Report Project W-23-2, Study 7.0. Juneau.

- Groot, C., and L. Margolis, editors. 1991. Pacific salmon life histories. University of British Columbia Press, Vancouver, British Columbia.
- Helle, J., R. Williamson, and J. Bailey. 1964. Intertidal ecology and life history of pink salmon at Olsen Creek, Prince William Sound, Alaska. USDI FWS, Special Scientific Report – Fisheries No. 483.
- Helle, J. H. 1966. Behavior of displaced adult pink salmon. Transactions of the American Fisheries Society 95(2):188-195.
- Heller, E. 1910. Mammals of the 1908 Alexander Alaska expedition, with descriptions of the localities visited and notes on the flora of the Prince William Sound region. University of California Publications in Zoology. 5(11):321–360.
- Hicks, B.G. 1982. Landslide terrain management using hazard zonation and risk Evaluations. USDA Forest Service. Rogue River N. F., Medford, OR
- Hilborn, R., and D. Eggers. 2000. A review of the hatchery programs for pink salmon in Prince William Sound and Kodiak Island, Alaska. Transactions of the American Fisheries Society 129: 333-350.
- Hodges, K. and D.E. Schmid. 1999. Eastern Prince William Sound wildstock salmon habitat restoration. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 97220). USDA Forest Service, Cordova, Alaska.
- Hollowell, G., B. Lewis, R. Merizon, and S. Moffitt. 2007. Prince William Sound Area finfish management report. ADFG, Fishery Mgmt Report No. 07-33, Anchorage, AK.
- Howse, N. 1975. Wildlife and fisheries resources inventory. Upper Prince William Sound Planning Unit B. Chugach National Forest. USDA FS Region 10.
- Isleib, M.E. and B. Kessel. 1973. Birds of the north gulf coast Prince William Sound region, Alaska. University of Alaska Press. Fairbanks, AK. 149 pp.
- Jansons, U., R.B. Hoekzema, J.M. Kurtak, and S.A. Fechner. 1984. Mineral occurrences in the Chugach National Forest, Southcentral Alaska: U.S. Bureau of Mines Report MLA5-84, 43 pp, Appendix, 2 plates.
- Johnson, F.C. John. 1984. Chugach Legends: Stories and Photographs of the Chugach Region. Chugach Alaska Corporation. Anchorage, Alaska.
- Joyce, T. 2007. Subsistence Fishing. Prepared for the Eastern Prince William Sound Landscape Assessment. Unpublished report on file, USDA FS, Chugach National Forest, Cordova Ranger District.
- Joyce, T. and D. Evans. 2000. Otolith marking of pink salmon in Prince William Sound salmon hatcheries. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 99188). ADFG, Div. of Commercial Fisheries, Cordova and Anchorage, Alaska.
- Kampshoff, M. C., R. A. Merizon, and S. D. Moffitt. 2005. Nelson Bay evaluation study for a proposed hatchery salmon remote release, 2004. ADFG, Fishery Data Series No. (unassigned), Anchorage, AK.
- Kampshoff, M. C., R. A. Merizon, and S. D. Moffitt. 2006. Inventory of wild stock salmon in Nelson Bay, Prince William Sound for a proposed hatchery salmon remote release, 2005. ADFG, Fishery Data Series No., Anchorage. (Draft. *in press*.)
- Kendall, S.J. and B.A. Agler. 1998. Distribution and abundance of Kittlitz's murrelets in southcentral and southeastern Alaska. Colonial Waterbirds 21(1):53-60.
- Kesti, S., M. Burcham, B. Campbell, D. Davidson, R. Develice, H. Hall, C. Huber, T. Joyce, D. Lang, B. MacFarlane, D. Sherman, and R. Velarde. 2007. Big Islands Landscape



- Assessment. Unpublished, USDA FS, Chugach National Forest, Cordova Ranger District. <http://www.fs.fed.us/r10/ro/policy-reports/>
- Kuletz, K. 1997. Marbled murrelet (*Brachyramphus marmoratus marmoratus*). Restoration Notebook, Exxon Valdez Oil Spill Trustee Council, Anchorage, AK.
- Lance, E.W., M.A. Bishop, and J. Mason. 1996. Songbirds detected during breeding surveys along the proposed Shepard Point Road corridor. Pages 58-65 (+append) in D. Scheel, N. R. Foster, and K.R. Hough. Habitat and biological assessment Sheppard Point Road and Port Project. Final Report. Prince William Sound Science Center, Cordova, AK.
- Lang, D. and K. Jurica. 2007. Knowles Head Watershed Restoration Plan, FY 2007 Fisheries Report. Unpublished report on file, USDA FS, Chugach National Forest, Cordova Ranger District.
- Lethcoe, J. and N. Lethcoe. 1994. History of Prince William Sound, Alaska. Prince William Sound Books, Valdez, Alaska.
- Lundquist, J. E. 2007. Pest Alert: Black-Headed Budworm in South Central Alaska. Unpublished. USDA FS Region 10, Anchorage AK, August 7, 2007. 3 pp.
- MacDonald, S.O. 2003. The amphibians and reptiles of Alaska: a field handbook, PDF. available at <http://aknhp.uaa.alaska.edu/herps/index.htm>. 44 p.
- MacFarlane, B. 2005. Hydrology report, prepared for the Big Islands landscape assessment. Unpublished report on file, USDA FS, Chugach NF, Cordova Ranger District.
- Markon, C. and B. Williams. 1996. Development of a geographical information system for the Chugach National Forest. Pages 155-163 in Remote sensing: people in partnership with technology. Proceedings of the sixth Forest Service remote sensing applications conference (J.D. Greer, Ed.). USDA FS and Society of Am. Foresters, Washington, D.C.
- McGowan, J.D. 1975. Distribution, density, and productivity of goshawks in interior Alaska. Final Rep. Fed. Aid in Wildl. Restor. Proj.W-17-3, 4, 5, 6 ADFG, Juneau. 57pp.
- McNair, M. 2002. Alaska salmon enhancement program 2001 annual report. ADFG, Regional Information Report 5J02-04. Juneau, AK.
- Merizon, R. S. Moffit, R. Brenner, S. Raborn and D. Norris. 2007. Straying of hatchery-derived chum salmon (*Oncorhynchus keta*) in Prince William Sound, Alaska. Presentation at 2007 Annual American Fisheries Society Meeting, Ketchikan, AK. ADFG Division of Commercial Fisheries, Anchorage, AK.
- Moyle, P. 1966. Feeding behavior of the glaucous-winged gull on an Alaskan salmon stream. Wilson Bulletin 78: 175-190.
- Murphy, M., J. Heifitz, J. Thedinga, S. Johnson, and K. Koski. 1989. Habitat utilization by juvenile Pacific salmon (*Oncorhynchus*) in the glacial Taku River, southeast Alaska. Canadian Journal of Fisheries and Aquatic Sciences 46:1677-1685.
- Murphy, M., R. Heintz, J. Short, M. Larsen, and S. Rice. 1999. Recovery of pink salmon spawning areas after the Exxon Valdez oil spill. Transactions of the American Fisheries Society 128:909-918.
- National Audubon Society. 2002. Audubon WatchList 2002: an early warning system for bird conservation. <http://www.audubon.org/bird/watchlist/index.html>
- Nelson, S.W. and M.L. Miller. 2000. Assessment of mineral resource tracts in the Chugach National Forest, Alaska: U.S. Geological Survey Open-File Report OFR00-026, 34 p.
- Otto, R.G. and J.E. McInerney. 1970. Development of salinity preference in pre-smolt coho salmon (*Oncorhynchus kisutch*). Journal of the Fisheries Research Board of Canada 27:793-800.

- Piatt, J. F., N.L. Naslund, and T. I. van Pelt. 1999. Discovery of a new Kittlitz's Murrelet nest: clues to habitat selection and nest-site fidelity. *Northwest Nat.* 80: 8-13.
- Post, A. and L. R. Mayo. 1971. Glacier Dammed Lakes and Outburst Floods in Alaska. United States Geological Survey, Hydrologic Investigations Atlas HA-455.
- Reeves, G.H., F.H. Everest, and T.E. Nickleson. 1989. Identification of physical habitats limiting the production of coho salmon in western Oregon and Washington. General Technical Report PNW-GTR-245. 18 p. Pacific Northwest Research Station. USDA Forest Service, Portland, Oregon.
- Reynolds, J.L. 1979. History and current status of the Sitka black-tailed deer in Prince William Sound. Pages 177-183 in O.C. Wallmo and J.W. Schoen, editors. *Sitka black-tailed deer: Proceedings of a conference in Juneau, AK*. USDA Forest Service, Alaska Region, Juneau, AK, Series No.R10-48. 231 pp.
- Reynolds, R.T., R.T. Graham, M.H. Reiser, R.L. Bassett, P.L. Kennedy, D.A. Boyce Jr., G. Goodwin, R. Smith, and E.L. Fisher. 1992. Management recommendations for the northern goshawk in the southwestern United States. USDA FS GTR RM-217, Ft. Collins, CO.
- Schelske, M., K. Hodges, and D.E. Schmid. 1998. Prince William Sound cutthroat trout, Dolly Varden inventory. *Exxon Valdez Oil Spill Restoration Project Final Report* (Restoration Project 97302), USDA Forest Service, Cordova, Alaska.
- Sease, J.L., and C.J. Gudmundson. 2002. Aerial and land-based surveys of Steller sea lions (*Eumetopias jubatus*) From the Western Stock in Alaska, June and July 2001 and 2002. *Journal: U.S. Dep. Comm., NOAA Tech. Memo. NMFS-AFSC-131*.
- Shishido, N. 1986. Seasonal distribution and habitat use by Sitka black-tailed deer in the Prince William Sound region, Alaska. M.S. Thesis. Univ. of Alaska, Fairbanks, 105 pp.
- Sloat, M. 2002. Knowles Head Watershed FY 2002 Fisheries Report: Fisheries & Watershed Monitoring Surveys. Unpublished report on file, USDA FS, Chugach National Forest, Cordova Ranger District.
- Snyder, C. (compiler) 2006. Forest Health Conditions in Alaska – 2005, A Forest Health Protection Report. USDA FS, AK Region, R10-PR-5, 92 pp.
- Snyder, C. (compiler) 2007. Forest Health Conditions in Alaska – 2006, A Forest Health Protection Report. *Edited by J Lundquist*. USDA FS, AK Region, R10-PR-11, 96 pp.
- Spies, R.B., S.D. Rice, D.A. Wolfe, and B.A. Wright. 1996. The effects of the Exxon Valdez oil spill on the Alaskan coastal environment. pgs 1 – 16. *In* S.D. Rice, R. B. Spies, D.A. Wolfe, and B.A Wright, editors. *Proceedings of the Exxon Valdez oil spill symposium*. American Fisheries Society Symposium 18.
- Stratton, L. 1989. Resource uses in Cordova, a coastal community of southcentral Alaska. Tech. Paper No. 153. ADFG, Division of Subsistence, Anchorage, AK. 171 pp.
- Stensvold, M. 2006. Sensitive Plants on the Chugach National Forest. Unpublished Admin. Paper. USDA FS, Alaska Region, Sitka, AK.
- Suring, L.H., W.B Dinneford, A.T. Doyle, R.W. Flynn, M.L. Orme, J.W. Schoen, and R.E. Wood. 1988. Habitat Capability Model for Mountain Goat in Southeast Alaska: Winter Habitat. Draft. USDA Forest Service, R10, Juneau, AK. 22 pp
- Swanston, D. N. 1997. Controlling stability characteristics of steep terrain with discussion of needed standardization for mass movement hazard indexing: A Resource Assessment. Included in *Assessments of Wildlife Viability, Old-Growth Timber Volume Estimates, Forested Wetlands, and Slope Stability*. Gen.Tech. Report PNW-GTE-392. pp. 44-58.

- Testa, J.W., D.E. Holleman, R.T. Bowyer, and J.B. Faro. 1994. Estimating Population of Marine River Otters in Prince William Sound, Alaska, Using Radiotracer Implants. *Journal of Mammalogy*, Vol. 75(4):1021-1032.
- Thorsteinson, F., J. Helle, and D. Birkholz. 1971. Salmon survival in intertidal zones of Prince William Sound streams in uplifted and subsided area. *in* The Great Alaska Earthquake of 1964: Biology. ISBN 0-309-01064-5. National Academy of Sciences. Washington, D.C.
- Titus, K., C. Flatten, and R.E. Lowell. 1994. Northern goshawk ecology and habitat relationships on the Tongass National Forest. ADFG Final Rep. Cont. No. 43-0109-3-0272. 69 pp.
- Titus, K. 1996. Goshawk ecology and habitat relationships on the Tongass National Forest. Alaska Dept Fish and Game, 1995 Field Season Prog. Rep. Unpubl. Draft.
- USDA Forest Service. 1976. Land system inventory guide. USDA, Forest Service, R1-76-20, Missoula, MT.
- USDA Forest Service. 1983. Chugach National Forest Environmental Atlas. USDA Forest Service, Alaska Region, Report Number 124.
- USDA Forest Service. 1992. A Channel Type Users Guide for the Tongass National Forest, Southeast Alaska. R10 Technical Paper 26, 179 pages.
- USDA Forest Service. 1993. National Hierarchical Framework of Ecological Units, ECOMAP, USDA FS, Washington, D. C.
- USDA Forest Service. 1999. Knowles Head watershed analysis. 1999 Progress Report. Unpublished report on file, USDA FS, Chugach NF, Cordova Ranger District.
- USDA Forest Service. 2002a. Revised Land and Resource Management Plan: Final Environmental Impact Statement, Chapters 1-6, Chugach National Forest. Alaska Region Manage. Bulletin R10-MB-480d, USDA FS, Chugach N.F., Anchorage, AK.
- USDA Forest Service. 2002b. Revised Land and Resource Management Plan: Record of Decision, Chugach National Forest. Alaska Region Management Bulletin R10-MB-480b, USDA FS, Chugach NF, Anchorage, AK.
- USDA Forest Service. 2002c. Revised Land and Resource Management Plan: Chugach National Forest. AK Region Mgmt. Bulletin R10-MB-480c, USDA FS, Chugach NF, Anchorage, AK.
- USDA Forest Service. 2002d. Second Amended Programmatic Agreement among the Forest Service, Alaska Region, The Advisory Council on Historic Preservation, and the Alaska State Historic Preservation Officer Regarding Heritage Resource Management on National Forests in the State of Alaska. Agreement #02MU-111001-076. On file USDA Forest Service, Anchorage, AK.
- USDA Forest Service. 1996-2002. Chugach National Forest Corporate GIS Data Layers. Accessed 2007. Landtype (July 2002), Lakes (updated 1998), Land Status (updated 2000), Roads (updated 2000), Streams (updated 2002), Watersheds (updated 1997), Wetlands (updated 1997), Timber Type (1978), Cover Type, Ecosections (updated 1997), Landcov (updated 1997).
- USDA Forest Service. 2005. Chugach Invasive Plant Plan. Alaska Region, Chugach National Forest, Anchorage, Alaska.
- USDA Forest Service. 2007a. Establishment record for the Olsen Bay Creek Research Natural Area within the Chugach National Forest, Alaska. Unpublished report on file with Forest Ecologist. USDA FS. Chugach National Forest. Anchorage, Alaska.

- USDA Forest Service. 2007b. Knowles Head Restoration Plan. Unpublished report on file, USDA Forest Service, Chugach National Forest, Cordova District. 77 pp.
- USDA Forest Service. 2007c. Prince William Sound Framework: *Measuring human use and mapping a "sense of place"*. July 2007 Draft Briefing Paper (4 pgs) and EVOS Administrative Study Proposals (6 pgs). Chugach National Forest.
- USDA Natural Resources Conservation Service. 1993. Soil Survey Manual. Soil Survey Division Staff - Soil Conservation Service. Superintendent of Documents, Washington D.C. USDA Handbook 18.
- USDI National Park Service. 1996. Restricted winter use report, Voyageurs National Park (1992-1996). Voyageurs National Park, International Falls, MN.
- USDI U.S. Fish and Wildlife, 2000, Seabird Colonies 2000 from USFWS Beringian Seabird Colony Catalog: ADFG and ADNR, Anchorage, Alaska
- US Geological Survey. 2007. Alaska National Water Inventory System Website Data Retrieval Page. <http://waterdata.usgs.gov/ak/nwis>. Downloaded August 2007.
- Wells, Jason. 2006. General Manager. Valdez Fisheries Development Association. Valdez, AK. Personal communication.
- Wertheimer, A., W. Smoker, T. Joyce, and W. Heard. 2001. Comment: a review of the hatchery programs for pink salmon in Prince William Sound and Kodiak Island, Alaska. *Transactions of the American Fisheries Society* 130:712-720.
- Western Regional Climate Center. 2007. Alaska Climate Summaries Webpage. <http://www.wrcc.dri.edu/summary/climsmak.html>. Downloaded August 2007.
- White B. 2005. Alaska salmon enhancement program 2004 annual report. ADFG, Fishery Management Report No. 05-09, Anchorage, AK.
- White B. 2006. Alaska salmon enhancement program 2005 annual report. ADFG, Fishery Management Report No. 06-19, Anchorage, AK.
- White B. 2007. Alaska salmon enhancement program 2006 annual report. ADFG, Fishery Management Report No. 07-04, Anchorage, AK.
- Wilkinson, C.E., M.D. Hocking, and T.E. Reimchen. 2005. Uptake of salmon-derived nitrogen by mosses and liverworts in coastal British Columbia. *Oikos* 108:85-98.
- Wittwer, D. (compiler) 2002. Forest Health Protection Report: Forest Insect and Disease Conditions in Alaska – 2001. USDA FS, AK Region, R10-TP-102, 66 pp.
- Wittwer, D. (compiler) 2003. Forest Health Protection Report: Forest Insect and Disease Conditions in Alaska – 2002. USDA FS, AK Region, R10-TP-113, 62 pp.
- Wittwer, D. (compiler) 2004. Forest Health Conditions in Alaska – 2003, A Forest Health Protection Report. USDA FS, AK Region, R10-TP-123, 82 pp.
- Wittwer, D. (compiler) 2005. Forest Health Conditions in Alaska – 2004, A Forest Health Protection Report. USDA FS, AK Region, R10-PR-3, 96 pp.
- Yarborough, L.F. 2000. Prehistoric and Early Historic Subsistence Patterns along the North Gulf of Alaska Coast. Ph.D. dissertation, University of Wisconsin – Madison.
- Yarborough, M.R. and L. F. Yarborough. 1997. Prehistoric Maritime Adaptations of Prince William Sound and the Pacific Coast of the Kenai Peninsula. *Arctic Anthropology* 35 (1): 132-145.

## **Appendix A – List of available resource reports and GIS products**

All reports and GIS products are electronically filed at the Cordova Ranger District office in J:\fsfiles\office\1900\_planning\land\_ass\e\_pws\. Hard copy reports are also available at the district office. Please be aware that Chapter 5 may be updated as projects are identified. These may be separate documents called “East Prince William Sound – Chapter 5 Update”.

Separate resources reports (\e\_pws\resource\_rpts\) include:

Fisheries Report – Ken Hodges

Heritage Resource report – Heather Hall

Hydrology Report – Bill MacFarlane

Lands Resource report – Bruce Campbell

Minerals and Geology report – Steve Hohensee

Recreation Report – Dixon Sherman

Soils and Erosion Processes report – Dan Svoboda

Subsistence Fisheries input – Tim Joyce

Wildlife Assessment report – Erin Cooper

Vegetation, Sensitive Plant, and Invasive Plant Report – Rob DeVelice

GIS products: (e\_pws\gis)

Several ArcMAP projects (xxx.mxd) are located in the GIS folder for the East Prince William Sound LA. The corporate database layers have been clipped to the analysis area boundary for lands status, Forest Plan direction, watershed boundaries, cover type, timber type, recreation polygon and point layers, streams, roads, trails, and bald eagles. JPEG & PDF files have been created from the information and the resulting maps are in the maps and figures folder.



## Appendix B – Land Stability Analysis Process on the Chugach National Forest

Assembled by Dean F. Davidson, retired Forest Soil Scientist

A land stability analysis is done on all major land disturbing activities proposed for sites that contain properties that frequent landslides. Red flags are fine texture soils of lacustrine origin, soils in or underlain with glacial till or outwash, poorly drained soils on slopes over 56%, shallow soils over an impermeable layer such as bedrock or compact glacial till.

The Standards and Guidelines in the Chugach Land Management Plan state “an analysis will be done for all major soil-disturbing activities greater than one-half acre in size, proposed on slopes from 56 to 72% and 0.10 acre in size on slopes greater than 72%. Initially a preliminary analysis is done in the office using available information. If sufficient indicators are thought to be present on the site, the office analysis will be followed with an on-site inspection and analysis. The analysis process used on the Chugach NF was developed by Hicks, B.G. (1982). This system uses the presence of features characteristic of landslides for the identification of landslides of all relative ages.

The Hicks risk assessment consists of identification of the presence of past and present landslides or landforms and soils with characteristics that normally contribute to a landslide. Aerial photography and available soils and landform data are good sources for information to help make the determination. The following categories are used to identify the risk for a landslide. Some characteristics for landslide identification are also included in the definitions.

### Levels of Landslide Activity and Indicators

<b>Active</b>	Currently active or active in the very recent past. May have fresh scarp or cracks. Leaning trees may indicate recent movements; such as a straight, healthy conifer leaning from the base can dictate recent movement. Broadly bowed, living conifer indicates movement over a period of time. Hummocky terrain with terrace-like slopes which are not deeply weathered may indicate recent movement.
<b>Possibly Active</b>	No clear indications of recent movement but landforms indicate movement in the past. Landslide features not so heavily weathered as to indicate long-term stability. Features are more subtle, often without obvious scarps or cracks. Possible low, constant creep rate that is currently creeping at a rate sufficiently slow that obvious cracks do not form.



**Inactive** No indication of movement is discernable from aerial photo interpretation or from field observation. However, significant soil removal, deep cuts from roads, tree removal or increase in water content because of management activities could accelerate or increase the potential for landslides or soil creep.

**Stable** No indication of movement is discernable from aerial photo interpretation or field observation. Landform and soil factors are not conducive to landslides or soil creep.

The more analytical Forest-wide standardization approach used by Douglas N. Swanston (1997) for hazard assessment for the Tongass Land Management Plan is used, with some minor adjustments, for on-site analysis on the Chugach NF. This system uses data that is easily collected in the field; such as soil properties including soil texture, parent material, depth, drainage; and specific topographic characteristics such as slope shape, length, gradient, and drainage density. The risk assessment weighs each of the characteristics as to their relative importance in landslide production and provides a relative numerical landslide failure rating for the site.

#### **Risk Assessment Categories**

**High to Extreme** Natural failures are often frequent and large, and there is a high risk of management-induced failure. Standard management practices can be expected to have only limited success, and on-the-ground assessment is necessary to determine the need for mitigating measures.

**Moderate** Natural failures are usually small and infrequent, but there is a moderate risk of management-induced failure. Standard and the best management practices are usually successful but on-the-ground investigation is still recommended. Mitigation measure may occasionally be needed.

**Low** Natural failures are usually rare or small. There is a low risk of management-induced failures except on unstable micro-sites such as scarps, V-notches, and stream banks. Standard best management practices that control stream flows and surface disturbances can be expected to be highly successful.

Used together, the Hick and Swanston risk assessment systems provide a solid basis to determine the potential for a landslide. One system is based on visual characteristics used to identify landslides and other system uses the analytical approach with data easily collected at the site.

The following spreadsheet shows the different criteria and the weighting that is used on the Chugach NF. The numerical rating is categorized into four ranges to give a relative potential derived from a repeatable process. The spreadsheet allows you to adjust a value and see what it would take to increase or reduce the potential for landslide occurrence, and hence estimate the effects of the proposed management activity.

Criteria	1	2	3	4	Criteria Value	Weighting Factor	Rating
<b>Landform</b>							
<b>Slope Shape</b>	Vertical	Broken	Convex	Concave-Straight	X	5	=
<b>Slope length (ft)</b>	0-300	301-700	701-1500	>1500	X	5	=
<b>Slope gradient (%)</b>	0-35	36-55	56-72	>72	X	20	=
<b>Drainage Features</b>							
<b>Drainage density (% of area)</b>	0-10	11-19	20-39	>40	X	10	=
<b>Soils and Geology</b>							
<b>Soil drainage class</b>	WD	MWD	SPD	VP, PD	X	10	=
<b>Soil depth (inches)</b>	>40	Not applicable	20-40	<20	X	5	=
<b>Parent material</b>	Carbonate, colluvium, alluvium	Noncarbonate, granitics, glacial till	Compact till, marine sediments	Volcanic ash	X	5	=
<b>Textural class</b>	Sand, gravel, fragmental loam	Loam	Silt	Silty clay	X	5	=
<b>Total of Ratings</b>							
<b>Failure Hazard Rating (&gt;63 = High, 62-50 = Moderate, 28-49 = low, &lt;28 = none)</b>							



## Appendix C – Public Involvement

During this analysis effort, notices were posted in the local paper and letters and emails were sent to 108 individuals, organizations, landowners, and Native, State, Federal and City agencies soliciting input in February of 2007. Eight responses were received and used to identify key questions, issues, and potential projects. Public comments received in 2002 during the Forest Plan revision and in 2005 during scoping for outfitter guide permits were used as well to focus discussion and develop key questions, issues, and potential projects. Table D.1 displays the comments and at what level the concern should be addressed. Some concerns are Forest Plan level concerns rather than project or landscape analysis level concerns.

For this analysis, request for input was sent to the following people and organizations:

Name	Name	Name
Acord Guide Service, Greg Acord	Alaska Center for the Environment	Alaska Alpine Adventures, Dan Oberlatz & Aaron Fetter
Alaska Association for Historic Preservation	Alaska Conservation Alliance	Alaska Earth Sciences, William Ellis
Alaska Historical Society	Alaska Miners Association, Steven Borell	Alaska Mountain Outfitters, Thad Richardson
Alaska Mountain Safaris, Bob Fithian	Alaska River Rafters, Mark & Robin Irving	Alaska Pacific University, Alicia and Steve Nooy
Alaska State Historic Preservation Office	Alaska State Dept of Natural Resources, Scott Maclean, Dave Griffin, Jack Sinclair, Mike Sullivan	AK Dept of Fish & Game – Cordova: Dave Crowley, Steve Moffit, Brian Marston, Bert Lewis
Alaska Wilderness Air Services	James A. Aquiar, Eagle Shellfish	Auklet Charter Service, Dave Janka ( + he gave to 2 others)
Anderson Island Lodge, Boris Popov operator	Babkin Charters, Alex & Brad Von Wichman	Torie Baker
Karl Becker and Nancy Bird	Luke Borer, Native Sun Charters	Lou Brown & Jon Miller
Bureau of Land Management	Darren Byler, Bylers Alaska Wilderness Adventures	Cascadia Wildlands Project & Alaska citizens for the Chugach, Gabriel Scott (+25 others)
Chenega Bay IRA Council	Chenega Corporation	Chugach Alaska Corp., Dave Phillips, Rick Rogers, & John Johnson
Copper River Watershed Project, Kristin Smith	Cordova Air, Dave Erbey	Cordova Chamber of Commerce
City of Cordova – City Planner, Museum	Cordova Coastal Outfitters, Andy Craig & Sewan Gehlbach	Cordova District Fisherman United, Catherine Crawford
Cordova Electric Coop., Ken Gates	Cordova Fish and Game Advisory Board, Tom Carpenter	Cordova Historical Society
George Covel	Tony D'Aoust, Univ of Fairbanks	Discovery Voyages, Dean Rand
Clare Doig	Alex Eaton, Matchsticks Prod.	Ecotrust, RJ Kopchak
Eyak Corp., Rob Worl & Dan McDaniel	Eyak Preservation Council, Dunnard Lankard	Native Village of Eyak, Robert Henricks & Bruce Cain
Fed. Aviation Admin., Rick Sudano	Fishing and Flying, Gail Ranney	Rick French
Gas and Time Alaskan Outfitters, Joe Romano	Jennifer Gibbons	Dick Groff
John Harvel	Halberd Charters	Dr. Jack Helle, Olsen Bay
Rod Hodgkin, Ravencroft Lodge	Ron Horton	Invasive Plant Group - UAF

<b>Name</b>	<b>Name</b>	<b>Name</b>
Mark Johnson, Institute of Marine Sciences, UAF	Jerry Klopp	Otto Kulm
Virginia Lacy	Nancy Lethcoe	Nora Laughlin, USFS, Juneau
Lonesome Dove Outfitters, Dennis Zadra	Richard Marson, Jack Bay resident	Paul McConnell
Jim McDaniel	Gary McDowell, Cordova Rose Lodge	Scott McRae
Rocky Morgan	The Nature Conservancy	National Wildlife Federation
National Outdoor Leadership School, Don Ford	Bert Nichols	Merri Ann and Steve Noey
Orca Lodge, Steve Ranney	Susan Ogle & Kelly Weaverling	Lauren Padawer
Points North, Kevin Quinn	Prince William Sound Aquaculture Corporation, Dave Reggiani	Prince William Sound Audubon, Milo Burcham
Prince William Sound Science Center, Nancy Bird	Prince William Sound Tourism Council, Clay Koplin	Ed and Deb Stevenson, Sheep River Hunting Camps
Dick Shellhorn	Bob Sanford	Sierra Club – Alaska
Bill Steffen, Sea Sound Charters	Bob and Linda Stump	Snug Corner Cove Lodge?
George Siavelis	Tatitlek Corp., Roy Totemoff	Tatitlek Village IRA Council
United States Coast Guard	U.S. Geological Survey	US Fish and Wildlife Service
City of Valdez - Planner	Valdez Fisheries Development Association, Jason Wells	Valdez H2O Heli-guides, Dean Cummings & Aaron Karitis
Valdez Heliski Guides, Scott Raynor	Vision Quest Adventures, Wade Willis	Fred Weltz
Wilderness Society – Alaska, Deborah Perkins	Woods Outfitting, Wayne Woods	

**Table D.1 - East Prince William Sound Analysis Comment Summary (April 2007)**

<b>#</b>	<b>issue - type</b>	<b>issue/service/ project description</b>	<b>concern</b>	<b>level to address</b>	<b>how to address</b>
1	mineral potential	Potential for increased interest in exploring for copper, zinc, & precious metals. Support CAC effort to enter into agreements to explore for & develop mineral res. on their lands	Supports village corporations & local communities in efforts to create jobs and economic development opportunities on USFS lands.	Landscape Assessment and when plans of operations submitted.	Identify potential in LA
1	mineral potential	Encourages FS as multiple use agency to develop management prescriptions that encourage mineral resource exploration & development in the area	Do not further restrict logging, fisheries, or mineral development.	Forest Plan level	In management prescriptions for Forest Plan
2	Wilderness character protection	Backcountry designation can be interpreted either to build cabins etc or leave as is. Protect wilderness character as it is.	Favors former wants to feel as if they are first people to visit a place, a common occurrence in east PWS.	Forest Plan	Forest plan spells out allowed activities for Back country

**Table D.1 - East Prince William Sound Analysis Comment Summary (April 2007)**

#	issue - type	issue/service/ project description	concern	level to address	how to address
2	commercial use	Excessive & hi impact commercial use is single greatest threat to experience in East PWS & natural landscapes. In past 2 decades have seen marked increase in use & abuse of NF lands. Comm. hunting camps, float lodges, charter flights, fishing charters, heliskiing, day & overnight cruises, & kayak charters all detract from the attraction of NF lands for private users.	Responder feels commercial uses have a place, but need to be closely regulated & limited in numbers to contribute to a sustainable economy and not degrade the natural resources that they are based on.	List as concern in LA, address further in recreation carrying capacity analysis.	In alternatives at project level when issuing permits.
2	enforce non-motorized winter use	Solomon gulch area (P198 and P222) is used by snow machines even though area is closed	Need to inform users and patrol area, especially in Jack Bay area since so accessible to Valdez.	ID in LA,	Provide signs, information in Valdez paper, and at visitor center, enforce
2	brown bear numbers	Brown bear numbers appear to be on the decline in Jack Bay. No longer present along Gregoreoff Cr. during spawning season seldom see then on Vlasoff Cr. and less often along Naomoff Cr.	Jack Bay is easily accessible, military boat rental, and recreation cabin, all contribute to heavy hunting pressure on brown bears.	ID as concern in LA and potential project.	work with ADFG to address issue by monitoring bear numbers
2	wilderness character protection	Encourage mgmt of Port Gravina and head of Fidalgo for non-commercial, non-developed recreation use: no guided hunting, fishing, tour-boat, or similar activities permitted.	Nothing takes charm and adventure out of an area like running into a hunting camp (head of Port Fidalgo) or floating lodge (near Beartrap in Gravina) or having low-flying charter air-craft (Whittier & Valdez).	Id as concern in LA & forward to carrying cap. analysis team. Address at project level analysis for SUP issue/ renew or not.	Responder - do not issue permits and do not renew existing Special Use Permits in Port Gravina. Address in project alternatives and mitigation.
2	boater safety	Gravina river is swift and winding at normal summer flows could be dangerous.	Developing this portage route may imply that it is an established and safe route.	During project development	Do not develop portage or choose route that avoids dangerous river portion. Address in project alternatives and mitigation.
2	visual concerns	Cutting portage would transform relatively undisturbed and undeveloped area.	Impacts to existing character.	Project development, id concern.	Address in project alternatives and mitigation.
2	brown bear disturbance	Portage would encourage concentrated use in what is presently one of the wildest parts of eastern PWS.	could increase disturbance to brown bear habitat	project development, id concern	Address in project alternatives and mitigation.
3	interest in applying for development of areas	Contact for volunteer projects and development projects in e psw. Formal response to come		project level	contact during project scoping
4	mineral potential	CAC lands may be a target for mineral exploration even though currently no active mines. Letter lists highly mineralized belt extending from Latouche Island, north-eastward through Ellamar, Tatitlek, Port Fidalgo, & ending near Copper River.	Supporter of Alaska's mining industry and is marketing lands for potential which includes zinc and copper.	id in LA and requests for access	Allow reasonable access to mining claims.

**Table D.1 - East Prince William Sound Analysis Comment Summary (April 2007)**

#	issue - type	issue/service/ project description	concern	level to address	how to address
4	Hunting /guiding/ outfitting	1 outfitter permitted on CAC lands. Considering a proposal from guide to conduct limited goat & bear hunts on CAC lands. Past permittees have complained about excess. pressures & trespass from unpermitted users.	CAC feels a presence on corporate land is needed to protect the resource & to ensure poaching & non-permitted commercial use of corporate lands is minimized.	describe in LA	Improve public education about private lands in PWS.
4	Heliskiing/ other recreation	CAC contacted by company to provide remote skiing adv. in area. None currently, but opportunity exists.		ID in LA as adjacent owners project & potential use.	Spell out mgmt of NF with regards to heliskiing.
5	subsistence	Subsistence use by Tatitlek residents should get primary concern. Seals, deer & salmon are important subsistence species.	Concerned about perceived difficulty of integrating village concerns into bureaucratic process as this.	LA/ project level.	Responder - visit village and listen to issues raised by people. FS does visit with native villages in Sound.
5	recreation and Tourism	Cumulative effects of tourism in the Sound. Tourism is getting out of control.	Examples - floating lodge in Beartrap Bay, heavy air taxi traffic between Gravina & Cdv, heliskiing traffic on east end of analysis area have degraded wildland exp. for them & others.	ID in LA, SUP admin., Carrying Capacity Analysis	Responder - Review of SUP and monitoring efforts. Informed responder that there is no lodge in Beartrap bay.
5	cabins	No new cabins or lodges on NF lands.	Enough opportunities for development on private lands.	id in LA	Responder - propose more trails into ongoing restoration efforts (Knowles Head is not to be developed per purchase agreement)
5	hunting and wildlife	Beartrap Bay taking a beating with regards to bear hunting. Feel FS should play a role in bear mgmt.	Hard data lacking due to ADFG tracking methods. Mgmt of healthy bear pop. are important for comm. opport., as guided hunts, local use as recreation, tourism, & for bears sake.	id in LA, work with ADFG.	Responder - FS biologist work with F&G biologists to do surveys & FS law enforcement enforce regulations and monitor guides and hunters.
5	Outfitting /guiding	Supports opportunities for big game guiding.	avoid over harvest as happened on Montague island brown bear	id in LA, project level analysis for SUP	Responder- A rational & scientific well-supported monitoring and permitting regime is essential
5	brown bear numbers	Numbers appear to have decreased in Jack Bay over past decade based on local residents observations	Jack Bay recreation cabin provides easy hunter access to critical early season foraging areas in Naomoff River salt marsh.	id in LA, potential projects	Use needs to be monitored
5	deer numbers	Increase in deer sign on mainland of PWS.	Hunting may become more common & increase. It is new species in ecosystem. FS should evaluate situation closely	id in LA, id as potential projects	Responder - would like to see research into impacts of trend on local wildlife, vegetation and human use
5	easements through private lands	Establish and maintain reasonable access foot trail for public to reach public lands. No NEW easements	FS easements should be clearly marked & maintained due to large amounts of no trespassing signs & private land in bays.	id in LA as potential projects	Provide information to public about private lands and easements

**Table D.1 - East Prince William Sound Analysis Comment Summary (April 2007)**

#	issue - type	issue/service/ project description	concern	level to address	how to address
5	restoration	Longer term forest restoration projects besides current ongoing projects on Knowles Head peninsula needed	Precommercial thinning with wildlife prescriptions (variable spacing) found to be beneficial elsewhere.	id in LA, listed as potential projects & in Knowles Head restoration plan	Responder - focus analysis at thinning riparian and beach fringe - the highest value habitat
5	water based uses and impacts	Forest Plan & projects ignore land and water interconnection. Need to consider water based activities. Unregulated water-based uses limit chances for solitude while impacting the marine environment in sometimes severe ways. FP inaccurately shows areas providing opport. for solitude that don't	Gravina, Fidalgo and Sheep Bay used by commercial seine fleet. Water-based use also impacts the land. Knowles Head is used as an anchorage by oil tankers & other large boats. Small cruise ships & charter craft used the eastern PWS.	Describe in LA. FS doesn't regulate or permit use of State waters.	Responder - have active monitoring program that could provide trends data and quantification of water-based use.
5	Places of Refuge Project	The POR project undertaken by State and Federal agencies to improve nautical accident response planning, identified potential sites for anchorage or grounding of damaged vessels.	Not clear if POR work Group had sufficient public & agency input to avoid unnecessary damage to valuable public resources in the event of a serious vessel-related spill.	Outside scope of this project - ID as a concern in LA.	Consultation between CNF, USCG, & DNR to ID hi-priority habitat, subsistence & rec. areas that should be protected rather than sacrificed in the event of vessel accidents.
5	special places	Gravina deserves special attention for protection	Wildest, prettiest and most productive country in e PWS. Floating lodge, flights in& out, detracts from aesthetic appeal & could be a real drain on the bears.	ID in LA and SUP issuance	Responder - keep commercial use to a minimum. Keep NF lands use non-commercial and primitive would help limit uses
5	special places	Port Fidalgo deserves special attention for protection	commercial uses, water-based impacts and recreation should receive mgmt attention	ID in LA and SUP issuance	same as above
5	special places	Jack Bay is destination point and important for small or open boats from Valdez	Jack Bay offers solitude scenic beauty, quiet & wildlife encounters. Potential threats incl. POR project, excess. brown bear hunting pressure, & landowner activities in homestead area.	describe uses in LA	Responder - manage to protect existing natural conditions into the future.
5	Conservation easement in Jack Bay	acquired in 2003 - 1000 acres on SW shore of Jack Bay - needs to be monitored and adjacent landowners informed of transfer	trees have been cut, trails created and construction mat'l left on easement.	describe in LA - inform public and monitor - project level	Responder - inform public & monitor adj. landowner actions affecting public lands. make sure are compatible with public enjoyment of NF lands.
6	existing uses	UAF has HF radar installations in PWS one is at Knowles Bay	ongoing research project - note in assessment	Note in LA	
7	boater safety	Gravina river is swift and winding at normal summer flows could be dangerous. And narrows at head of Fidalgo can be closed off by rocks at low tide.	Depending on season - Gravina river can be passable or too high for boating. Depending on tide Fidalgo narrows can be passable or not	note in LA and project development	Consider signs to inform people to hike trail to see if floatable or construct trail so avoid Gravina river & go to tidal slough instead. Make sure folks aware of tides in Fidalgo.



**Table D.1 - East Prince William Sound Analysis Comment Summary (April 2007)**

#	issue - type	issue/service/ project description	concern	level to address	how to address
7	campsite	suggest hardened site on either end of portage	to reduce resource damage	describe in LA and project level	consider as project
7	recreation and Tourism	Provide map for hardened sites and land ownership, especially for kayakers.	So people do not trespass & to min. resource damage. Put enough easements in Fidalgo.	note in LA - id as project	id as project
7	recreation and Tourism	No need for additional developed sites.	enough private infrastructure in place; State Marine park in Jack Bay, lodges in Snug Corner, Ellamar, & bear camp in Gravina	note in LA	
7	outfitting/ guiding	Does not want to see guided bear hunting in area.	concerned about impacts	note in LA	consider during SUP issuance
8	scenery	Consider maintenance of quality, natural - appearing scenery as a major issue.		addressed in Forest Plan, note in LA	consider during project development

Table D.3 summarizes comments received during the revision of the Forest Plan that pertain to this analysis area. They are from the Public Content Category Report- Working Papers, Forest Plan Revision Team March 1998.

**Table D.2 - Forest Plan Revision Comments received pertaining to East Prince William Sound Analysis Area (March 1998)**

Page	#	Comment
8-89	179-001	Tatitlek Corporation – manage for multiple use, timber and habitat mgmt for high level of hunting, fishing, gathering and destination recreation
	179-003	Tatitlek Corporation – cooperate with adjacent Native Corporation landowners especially concerning access.
	179-004	Tatitlek Corporation – recognize communities of PWS depend on NF land for existence
	191-002	Balance uses
10-13	810-016	Wildlife – whales, seabird observations
	817-020	Habitat needs of Seabirds
	817-021	Habitat needs of Murrelets
	817-022	Habitat needs of Harlequin ducks
	817-024	Habitat needs of shorebirds & black oystercatchers
	817-025	Habitat needs of raptors
	817-026	Habitat needs of songbirds
	817-027	Habitat needs of Steller Sea lions
	817-028	Impacts to Sea lions from transportation/ recreation & tourism, Education needed.
	817-034	Habitat needs of river otter
	836-005	Impacts to seabird colony from boat activity.